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PHYSICS ABSTRACTS

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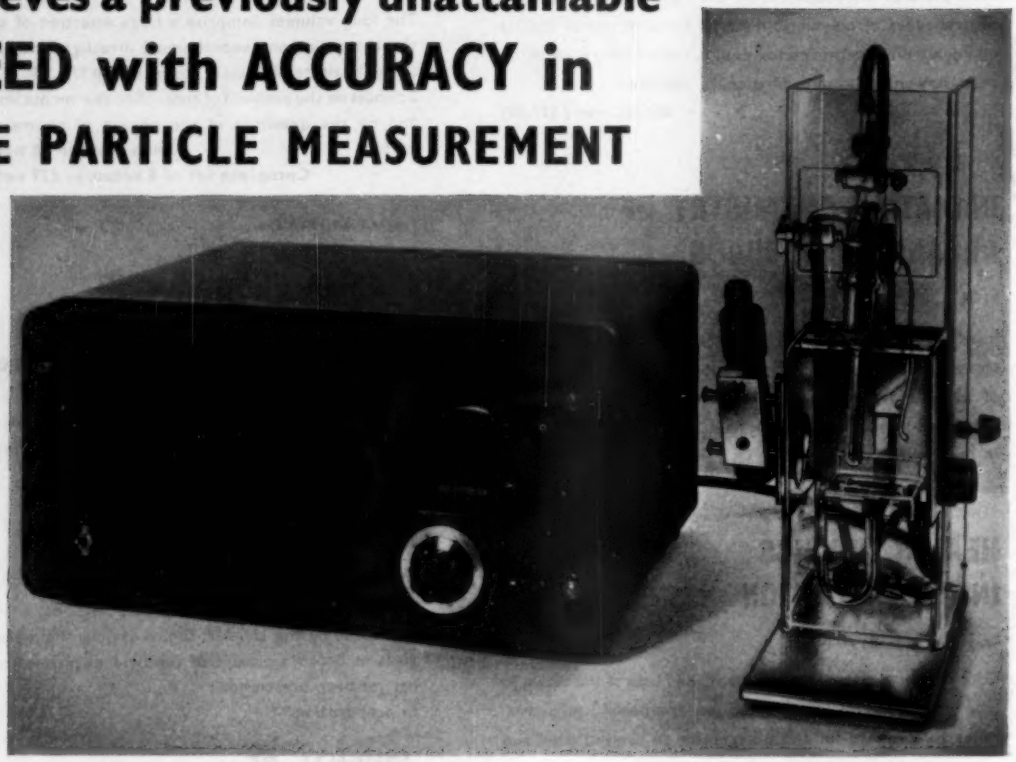

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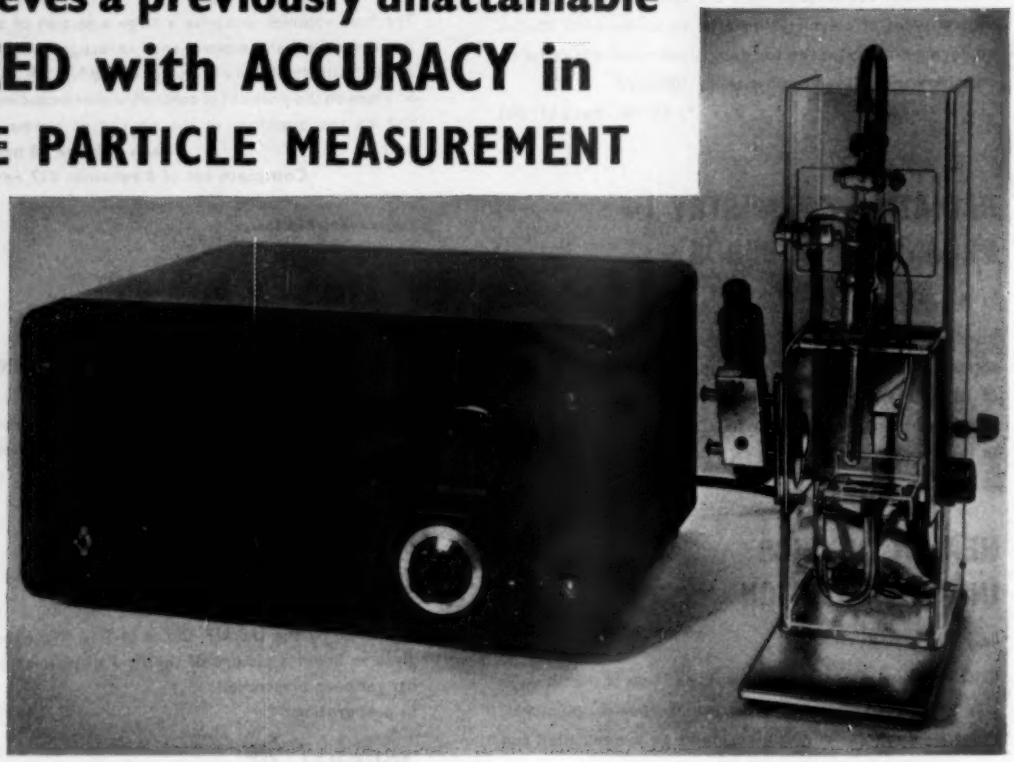

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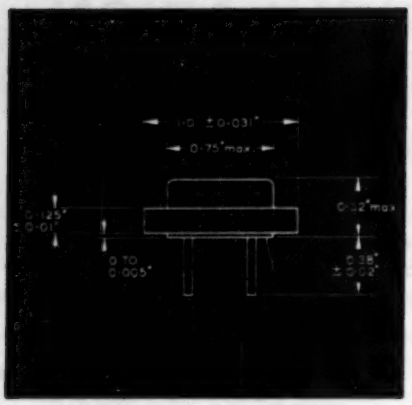

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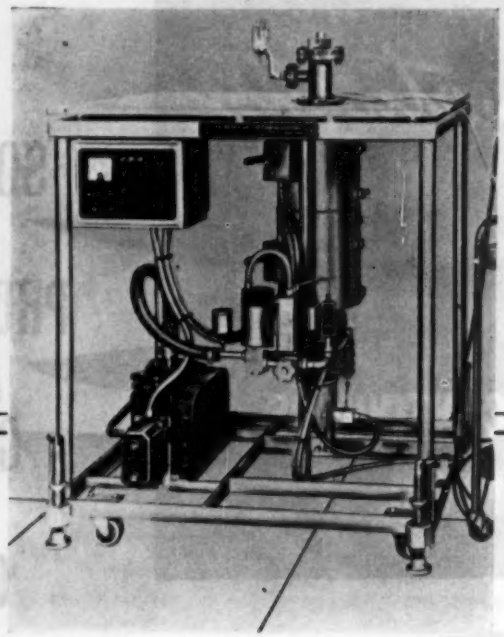

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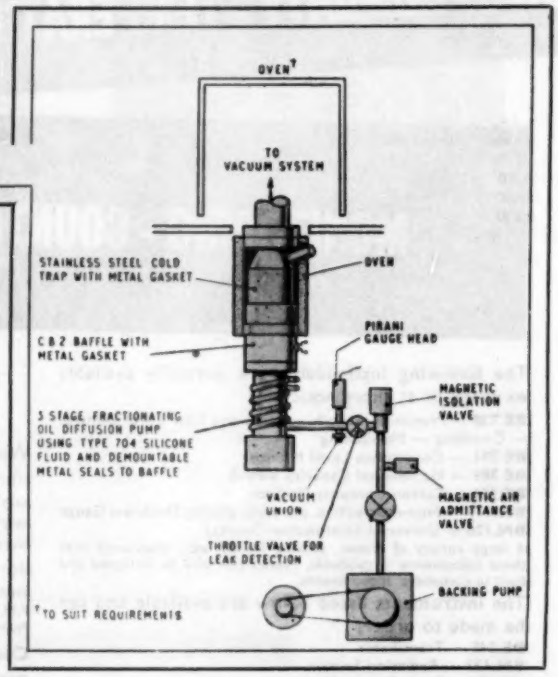
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MATHEMATICS

512

4635 DECOMPOSITION OF 3 × 3 MATRICES. P.Roman.
Proc. Phys. Soc., Vol. 74, Pt 6, 649-52 (Nov., 1959).

Starting from the 3-dimensional Kemmer algebra, a new semi-simple algebra, containing 9 base elements, is developed which allows the expansion of any 3 × 3 matrix. P.Roman

517

4636 THE SPHERICAL FUNCTIONS OF LEGENDRE AND SPHEROIDAL FUNCTIONS. VOLUME III.
[Fonctions sphériques de Legendre et fonctions sphéroidales].
L.Robin.
Paris: Gauthier-Villars (1959) viii + 289 pp. [Collection Technique et Scientifique du C.N.E.T.]. In French.

[For Volumes I and II see Abstr. 2089 (1958) and 6435 (1959)]. This volume completes perhaps the most extensive treatise on the Legendre and related functions, bringing the total number of pages to more than nine hundred. Volumes I and II dealt with the basic definitions and general properties of these functions; Volume III, comprising chapters VII to X, continues this work with the treatment of more specific properties which are all of the utmost importance in applied mathematics. Thus chapter VII deals with the addition theorems and formulae for the functions $P_n(\mu)$, $Q_n(\mu)$ and $P_n^m(\mu)$, for all values of μ and n and, in the latter case, integral values of m, positive, negative or zero. Chapter VIII is devoted to the zeros of $P_n^m(\mu)$ and $Q_n^m(\mu)$ for real values of n and m. Chapter IX deals with applications of the Legendre functions to surfaces of revolution with systems of orthogonal curvilinear coordinates other than spherical coordinates. Among the surfaces considered are those of the ellipsoid of revolution, the circular torus and the cone. The final chapter is given to functions related to those of Legendre such as Gegenbauer polynomials and functions and spheroidal functions. There are two appendices, the first of which deals very briefly with spherical Bessel functions. The second appendix gives a most comprehensive list of numerical tables of Legendre functions existing at the end of 1958. There are ten figures. Each volume is supplied with an alphabetical index as well as the usual table of contents. T.R.Carson

517

4637 THE METHOD OF IMAGES AND THE SOLUTION OF CERTAIN PARTIAL DIFFERENTIAL EQUATIONS.
G.Rowlands.
Appl. sci. Res. B, Vol. 8, No. 1, 62-72 (1959).

A series solution of certain partial differential equations is obtained by a generalization of the electrostatics method of images. Over certain ranges of the variables, these series solutions are more rapidly convergent than the usual solution in terms of orthogonal functions. In general, these two types of solution are to be taken as complementary.

517

4638 ASYMPTOTIC SOLUTIONS OF DIFFERENTIAL EQUATIONS WITH TRANSITION POINTS OR SINGULARITIES. A.Erdélyi.
J. math. Phys. (New York), Vol. 1, No. 1, 16-26 (Jan.-Feb., 1960).

Asymptotic solutions of $d^2y/dx^2 + [\lambda^2 p(x) + r(x,\lambda)]y = 0$ are found when λ is a large parameter and r is "small" in comparison with $\lambda^2 p$, except at a single point where either p has a simple zero, or p a pole of the first order and r a pole of the second order. The results are applied to Bessel functions, and to Hermite and Laguerre polynomials. The resulting asymptotic forms are valid uniformly in x.

517 : 536.56

THE DISTRIBUTIONS OF ONE VARIABLE: RELATIONS BETWEEN TWO DEFINITIONS, DIFFERENTIATION, INTEGRATION.
See Abstr. 3844

518 : 681.142

4639 REPETITIVE ANALOG COMPUTER FOR ANALYSIS OF SUMS OF DISTRIBUTION FUNCTIONS.
F.W.Noble, J.E.Hayes, Jr and M.Eden.
Proc. Inst. Radio Engrs, Vol. 47, No. 11, 1952-8 (Nov., 1959).

Many experimental procedures yield curves which are sums of distribution functions. Examples of such curves include electrophoretic, diffusion, and ultracentrifugal patterns, absorption spectra, and curves from countercurrent distribution and from partition chromatography in either liquid or vapour phase. In a given type of curve, each of the component functions is identical to the others in form (for example Gaussian) but can have very different values of the parameters governing height, width, and position along the abscissa. The parameters for each component are to be determined by an analysis of the sum curve. The computer to be described performs this analysis by synthesizing a number of distribution functions of the desired form, each with adjustable parameters, and presenting, on an oscilloscope, the sum of these functions for comparison with the experimental curve being analysed. A match is made visually by adjustment of the various parameters. When a match has been obtained, the parameters of the component functions are read out, following a switching procedure which presents the individual functions in sequence.

518.5 : 681.142

4640 ANALOGUE COMPUTER FOR THE SOLUTION OF PRODUCT INTEGRALS. F.D.Penny and J.W.McHugo.
J. sci. Instrum., Vol. 36, No. 4, 173-9 (April, 1959).

The computer will accept up to three input variables simultaneously; they are presented in the form of recorder chart traces which are traversed mechanically, but are followed by hand. The instantaneous product of the input variables, or of some pre-selected function of them, is formed and charted. Mechanical integrators compute the integrals of each of the input variables and of the product. The particular arrangement described computes $\int ab\sqrt{c}\,dt$, $\int a\,dt$, $\int b\,dt$ and $\int \sqrt{c}\,dt$ where a(t), b(t) and c(t) are the input variables.

518.5 : 681.142

4641 SIMPLE ELECTRICAL ANALOGUE FOR THE SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS. D.B.Dove.
J. sci. Instrum., Vol. 36, No. 11, 474-5 (Nov., 1959).

A simple resistance analogue provides a rapid solution for simultaneous equations of the type $y_i = a_{ij}x_j$, where $a_{ij} = 0$, $i > j$.

518.5 : 539.2 : 548.7

4642 MECHANICAL STRUCTURE-FACTOR COMPUTER. W.Schaffer.
J. sci. Instrum., Vol. 36, No. 2, 75-7 (Feb., 1959).

The construction and use of a machine for computing sums of sine and cosine series, such as those required for structure factors in crystallography, is described. The machine is entirely mechanical and carries out the whole computation. It saves about half the time usually taken and is sufficiently accurate for most purposes.

518.5

4643 LIENARD PHASE PLANE INTEGRAPH. R.Butler.
J. sci. Instrum., Vol. 36, No. 4, 172-3 (April, 1959).

A mechanical linkage is suggested for obtaining trajectories,

corresponding to damped oscillations, in the Liénard plane. Its construction is based on the Henrici–Coradi instruments, although, as a second order differential equation is being analysed here, the mechanism is more intricate.

ASTROPHYSICS

522.6

4844 ANCILLARY APPARATUS FOR THE DIRECT RECORDING OF INTENSITY CURVES WITH A MICRO-PHOTOMETER. J.Richter.
Z. Astrophys., Vol. 48, No. 3, 159-62 (1959). In German.

Based on an optical principle employed by Minnaert and Houtgast (1957) a modification to the conventional microdensitometer is described that enables the instrument to be used as a direct recording intensity-scale microphotometer. The complete apparatus includes a photomultiplier receiver. It is designed specifically for the photometry of photographic plates. D.R.Barber

522.9

4845 SYSTEMATIC ERROR IN THE MEASUREMENT OF THE DIAMETERS OF SMALL CELESTIAL BODIES WITH THE DOUBLE-IMAGE MICROMETER. H.Camichel.
Ann. Astrophys., Vol. 21, No. 4, 217-28 (July-Aug., 1958). In French.

The measurement of the diameter of small disks involves a systematic error due to deformation of the edge caused by diffraction. This error is of the order of 1/100 to 2/100 for Jupiter's satellites under normal conditions of observation. Laboratory measurements on artificial disks seem to confirm this effect. Direct measurements have greater errors in comparison with which this systematic error should be considered as negligible.

523.16

4846 SEARCHING FOR INTERSTELLAR COMMUNICATIONS. G.Cocconi and P.Morrison.
Nature (London), Vol. 184, 844-6 (Sept. 19, 1959).

It is suggested that technically advanced societies may have evolved on planets of nearby stars and that they may be attempting to communicate with the solar system. The most suitable communication frequency is shown to be about 10^4 Mc/s when account is taken of the atmosphere of the planets and solar and galactic radio emission. A search in the neighbourhood of the 1420 Mc/s emission line from neutral hydrogen appears reasonable. The transmitted power required to be distinguishable from the 1420 Mc/s background radiation is within the capabilities of even our civilization if transmitting and receiving aerials 100 metres in diameter are used. It is suggested that the search should be made within ± 500 kc/s of the hydrogen line with normal hydrogen-line bandwidths but long integrating time constants. Seven stars likely to have planetary systems lie within 15 light years of the sun. R.D.Davies

523.16 : 551.5

4847 MEASUREMENT OF COSMIC NOISE AT LOW FREQUENCIES ABOVE THE IONOSPHERE. J.P.I.Tyas, C.A.Franklin and A.R.Molozzi.
Nature (London), Vol. 184, 785-6 (Sept. 12, 1959).

A 2-15 Mc/s swept-frequency ionosphere sounder is being designed and is to be launched as an earth satellite. It is thought that cosmic noise will be an important factor limiting its sensitivity. Some features of a radiometer to be launched in a rocket or satellite, in order to measure the noise, are discussed. Data are given relating to the transistor receiver to be used, the magnetic dipole (ferrite) aerial and the methods of stabilization of gain and bandwidth. An avalanche diode is used as a reference noise source and an overall accuracy of ± 2dB is predicted for the measured cosmic noise intensity. G.D.Sims

523.16

4848 CHARACTERISTICS OF AN EXCEPTIONAL SOLAR EMISSION AT 169 Mc/s, OBSERVED ON 4 NOVEMBER, 1957. Y.Avignon, A.Boischot and P.Simon.
Ann. Astrophys., Vol. 21, No. 5, 243-9 (Sept.-Oct., 1958). In French.

This emission was markedly different from emissions characterizing noise storms and bursts generally associated with chromospheric flares. It is suggested that some of the observed fluctuations originate in a scintillation phenomena close to the earth.

523.16

4849 STUDY OF SOLAR RADIO EMISSION AT 169 Mc/s, USING A LARGE GRATING (MULTI-AERIAL) INTERFEROMETER. A.Boischot.
Ann. Astrophys., Vol. 121, No. 6, 273-344 (Nov.-Dec., 1958). In French.

The Nançay interferometer, designed especially for solar studies at meter wavelengths, is briefly described. It has a resolving power of 3' 8 at 169 Mc/s and is able to locate the sources of enhanced radiation in the East-West direction with an accuracy better than 1 minute. The methods used are discussed, giving in each case the accuracy obtained. Different types of solar radio emission are described : radiation from the quiet sun, including a new type of slowly varying component; the general properties of the noise-storm sources (position, diameter, height, etc); and a new flare-associated emission (the type IV burst).

523.16

4850 STUDY OF THE SLOWLY VARYING COMPONENT OF SOLAR RADIO EMISSION. B.Vauquois.
Ann. Astrophys., Vol. 22, No. 3, 189-248 (May-June, 1959) In French.

A statistical analysis of this component is made using the total intensity measurements of several observatories from 1950 to 1955. Only centimetric and decimetric waves are considered, since metre waves show other important and intense phenomena superimposed upon the slowly varying component. The whole of this analysis is based on the notion of the "radio-emissive centre" which would correspond to a disturbed region in the solar atmosphere radiating the whole spectrum. Some typical features of these are investigated, and a model of such a centre is suggested. Relations are established between the centres and the associated optical phenomena : sunspots, faculae, coronal green line emission. The effect of the position θ and of the age τ of a centre upon its radio properties is studied. It is found that the relation with θ is a limb darkening function, well approximated by a $\cos\theta$ law for the highest frequencies; the functions deduced for lower frequencies lie higher than a $\cos\theta$ law. In the case of the age τ it is found that the centres remain observable after the associated sunspot has disappeared but vanishes before the associated facula. A model of such a disturbed region is proposed on the basis of these data and assuming two further hypotheses : the radio emission is of thermal origin; the general shape of the region is simple.

523.16

4851 SOLAR BRIGHTNESS DISTRIBUTION AT A WAVE-LENGTH OF 60 CENTIMETRES. II. LOCALIZED RADIO BRIGHT REGIONS. G.Swarup and R.Parthasarathy.
Austral. J. Phys., Vol. 11, No. 3, 338-49 (Sept., 1958).

For Pt I, see Abstr. 4778 of 1956. The localized radio bright regions on the sun which give rise to a slowly varying component of the solar radiation were studied at a wavelength of 60 cm, using a 32 aerial interferometer with a beamwidth of 8.7 min of arc. The observations were undertaken during July 1954 to March 1955 and were limited in number due to this being a minimum period of the solar cycle. The low activity, however, provided the advantage of simple interpretation as often only one region was present on the solar disk. The characteristics of the observed bright regions are described; their occurrence is closely correlated with regions of chromospheric faculae, the emission polar diagram has a half-power width of 6 days, the estimated size of the sources varied from less than 3 to 6 min of arc, the largest value of the derived brightness temperature was 10^7 °K, and for two groups of localized regions the height of the source was derived to be 35 000 ± 15 000 km above the photosphere. Sometimes the slowly varying component showed marked intensity fluctuations in periods of nearly half an hour. The presence of apparently associated fluctuations suggests that at least a part of the slowly varying component at 60 cm has a non-thermal origin.

523.16

4852 STRUCTURE AND PROPERTIES OF SOURCES OF SOLAR ACTIVITY ON CENTIMETRE WAVES.

M.R.Kundu.

Ann. Astrophys., Vol. 22, No. 1, 1-100 (Jan-Feb., 1959). In French.

A two-aerial interferometer has been constructed for the study of localized sources (persistent sources and bursts) at 3.23 cm. The two aerials are in equatorial mounting and are disposed on an E–W base line at a distance of 60 m from each other. The variation of the resolving power due to the diurnal motion is utilized to measure the dimensions and distribution of the brightness of these sources. Observations with this instrument have produced new evidence on several properties of these sources : evolution, apparent diameter, polarization, etc. which clarify their classification and give new clues to their interpretations and their association with the corresponding phenomena observed in optics and on decimeter and meter waves. One has also to show an extremely close relationship between the ionization of the E-layer of the ionosphere and 10-7 cm solar radiation.

523.16

4853 SOLAR RADIO BURSTS OF SPECTRAL TYPE II. J.A.Roberts.

Austral. J. Phys., Vol. 12, No. 4, 327-56 (Dec., 1959).

The characteristics of bursts of spectral type II are studied in a sample of 65 bursts. Approximately half the bursts show harmonic structure and about half are compound type III–type II events. Band splitting, the doubling of both the fundamental and second harmonic bands, is also relatively common. A rather less common feature is the appearance of herring-bone structure in which the slowly drifting band of the type II burst appears to be a source from which rapidly drifting elements diverge towards lower and higher frequencies. Statistics are given of the rate of occurrence of the bursts, their frequency range, the rate of frequency drift, and the harmonic ratio. Many of the type II bursts occurred near or after the maximum of a chromospheric flare. However, only about 3% of flares (of Class 1 or greater) are accompanied by type II bursts, although the figure rises to 30% for Class 3 flares. There is a greater tendency for the geomagnetic field to be disturbed in the few days following a type II burst than there is after large flares which are not accompanied by type II bursts, or after large radio bursts of spectral type III. Statistically the greatest disturbance occurs after about two days, implying a mean speed of travel of about 1000 km/sec.

523.16

4854 FLARE-PUFFS AS A CAUSE OF TYPE III RADIO BURSTS. R.G.Giovanelli.

Austral. J. Phys., Vol. 11, No. 3, 350-2 (Sept., 1958).

An analysis has been made of the association of type III solar radio bursts with flares which show sudden bright expansions, or "puffs". Type III bursts occur within ±2 min of the times of two-thirds of the puffs; by comparison, they occur during the whole lifetimes of about one-quarter of flares of all types (Abstr. 4630 of 1958). Most, if not all, puffs are followed by surges, and hence it appears that the same explosion yields two quite different ejections; one, at velocities of the order of one-fifth that of light, is responsible for the burst, and the other, at velocities of the order of 100 km/sec, is the surge.

523.16

4855 AN INVESTIGATION OF THE SPEED OF THE SOLAR DISTURBANCES RESPONSIBLE FOR TYPE III RADIO BURSTS. J.P.Wild, K.V.Sheridan and A.A.Neylan.

Austral. J. Phys., Vol. 12, No. 4, 369-98 (Dec., 1959).

Describes an investigation aimed at finding out whether type III bursts are due to disturbances which travel out through the corona with velocities exceeding 0.1c, as predicted by the hypothesis that the emissions are due to plasma oscillations. If the proposition is correct, emissions at different frequencies would be generated at different levels in the corona — the lower the frequency the higher the source. This property is tested by simultaneous directional observations at a number of frequencies between 40 and 70 Mc/s, using a swept-frequency interferometer. The system and performance of the interferometer are described, and errors in position-finding due to ionospheric refraction are discussed. Results for type III bursts show that different frequencies are generated at different levels in the corona according to the predicted sequence; they therefore strongly support the plasma hypothesis. It is concluded that the corona is considerably denser in the regions where type III sources are generated than in the average corona as depicted by conventional models; and an origin in coronal streamers is suggested. The derived velocities of type III disturbances are found to be considerably greater than those previously deduced from spectral data alone. The range of velocities now inferred extends from 0.2c to 0.8c, with an average of 0.45c. The significance of these very high velocities is discussed. For this purpose new evidence is discussed. For this purpose new evidence is discussed relating to the "type V" continuum emission which follows certain type III events. The combined type III-V events, which are known to correlate closely with chromospheric flares and sub-flares, are interpreted in terms of streams of relativistic electrons with energies $> \sim 2$ MeV which travel along magnetic lines of force in spiral paths. It is suggested that, in its outward passage, such a stream excites plasma oscillations in the surrounding coronal gas (yielding the type III burst), while, under favourable circumstances, the electrons themselves emit synchrotron radiation (yielding the type V burst). A possible connection between the energetic solar electrons and the corpuscular radiation surrounding the earth is suggested.

523.16

4856 AN ASSOCIATION BETWEEN SOLAR RADIO BURSTS AT METRE AND CENTIMETRE WAVELENGTHS. A.A.Neylan.

Austral. J. Phys., Vol. 12, No. 4, 399-403 (Dec., 1959).

From a study of simultaneous metre and centimetre solar radio bursts, it appears that the type III events which coincide with centimetre bursts are frequently followed by a particular form of broad-band emission. This last burst, termed type V, is observed mainly below 150 Mc/s on radio spectrum records where it resembles a bright glow lasting for about 1 min. Synchrotron radiation has been suggested as the mechanism for type V bursts. The accompanied centimetre burst lasts a length of time comparable with that of the metre bursts, is indistinguishable in intensity from unaccompanied centimetre bursts, and, on present evidence, may be due to either thermal or synchrotron radiation. A stream of highly energetic particles ejected from a flare region on the sun is suggested as the cause of both events, exciting centimetre bursts in or near the chromosphere and type V bursts at large heights in the corona.

523.16

4857 LOCATION OF THE SOURCES OF 19 Mc/s SOLAR BURSTS. C.A.Shain and C.S.Higgins.

Austral. J. Phys., Vol. 12, No. 4, 357-68 (Dec., 1959).

By using large aerials in a new way, it has been possible to locate, with considerable accuracy, the sources of 19 Mc/s solar bursts. The positions of these sources have been correlated with the positions of optically active regions associated with them, and the radial distances of the radio sources from the centre of the sun have been deduced. In 1950-51, 18.3 Mc/s bursts came from sources at a radial distance estimated as $3.4R^{\circ}$; more reliable data in 1957 indicated that the sources of 19.7 Mc/s bursts were at a radial distance of $2.9R^{\circ}$. It is thought that these measurements give the distances of the fundamental plasma levels in coronal streamers.

523.16 : 537.59

4858 RELATION BETWEEN THE EMISSION OF COSMIC RAYS FROM THE SUN AND BURSTS OF TYPE IV. Y.Avignon and M.Pick-Gutmann.

C.R. Acad. Sci. (Paris). Vol. 249, No. 22, 2276-8 (Nov. 30, 1959). In French.

The list prepared by Leinback and Reid of increases of cosmic rays detected near the earth during the International Geophysical Year is compared with 10 cm bursts of type IV. The most energetic bursts of this type are clearly associated with cosmic-ray increases. This association confirms the suggestion that type IV bursts contain synchrotron radiation. It was found that bursts associated with intense flares occurring to the west of the solar meridian were most likely to be accompanied by any increase of cosmic rays.

R.D.Davies

523.16

4859 OBSERVATIONS OF THE FINE STRUCTURE OF ENHANCED SOLAR RADIO RADIATION WITH A NARROW-BAND SPECTRUM ANALYSER. O.Elgarøy.

Nature (London), Vol. 184, 887-8 (Sept. 19, 1959).

Preliminary observations with high time-resolution are made of storm (Type I) bursts using a bandwidth of 0.3 Mc/s which sweeps the frequency range 190 to 215 Mc/s fifty times per second. Many of the bursts showed a frequency drift with time, commonly in the range 2-5 Mc/s per second. Sometimes complex frequency drifts existed,

occasionally reversing in sign. On Aug. 18, 1959, the radiation was nearly completely polarized and the noise-storm bursts had a bandwidth of about 2 Mc/s. The total lifetime of a burst was about 2-3 sec and the drift rate was 2-4 Mc/s per second. R.D.Davies

523.16

4860 THE RADIO CONTINUUM RADIATION FROM THE GALAXY. B.Y.Mills.

Publ. Astron. Soc. Pacific, Vol. 71, 267-91 (Aug., 1959).

A review of present knowledge of the origin and distribution of radio emission from the Galaxy. The radiation arises in a thermal component associated with H II regions and a non-thermal one which appears to have three basic divisions, (1) an extensive component of small axial ratio called the "corona" or "halo", (2) a brighter component confined to the galactic plane and concentrated towards the centre of the Galaxy, (3) a population of intense sources concentrated about the Galactic plane. After discussing the mechanism of synchrotron radiation which is accepted as the most probable mechanism for the generation of the non-thermal emission the distribution of these components is considered in more detail. C.Hazard

523.16

4861 A PENCIL-BEAM SURVEY OF THE GALACTIC PLANE AT 3.5 m. E.R.Hill, O.B.Slee and B.Y.Mills.

Austral. J. Phys., Vol. 11, No. 4, 530-49 (Dec., 1958).

A survey has been made of the galactic plane region from $l = 223°$ through the galactic centre to $l = 13°$ between $b = +4°$ and $-6°$ using the 3.5 m wavelength cross-type aerial (beamwidth 50 min of arc) near Sydney. Contour diagrams of brightness temperature have been prepared. The preparation of contours is described in detail, and a detailed discussion of the accuracy of the temperatures is given.

523.16

4862 ON THE RADIO EMISSION OF HYDROGEN NEBULAE. C.M.Wade.

Austral. J. Phys., Vol. 11, No. 3, 388-99 (Sept., 1958).

The interpretation of radio-frequency observations of H II regions is discussed with particular regard for the possible effects of random variations in the electron density and electron temperature through the nebulae. It is shown that such variations serve to alter the optical depth and that the conventional definition of the "emission measure" requires modification if it is to be considered an observable quantity. The radio emission of Strömgren spheres is discussed, and a means of determining their electron temperatures is described. An empirical method for the determination of Strömgren's constant defining the ionized volume as a function of the spectral type and luminosity of the exciting star is described.

523.16

4863 OCCULTATIONS OF THE CRAB NEBULA BY THE SOLAR CORONA IN JUNE 1957 AND 1958.

O.B.Slee.

Austral. J. Phys., Vol. 12, No. 2, 134-56 (June, 1959).

A description is given of some observations of the occultations of the Crab nebula by the solar corona in June 1957 and 1958, obtained with pencil-beam, fan-beam, and interferometer-type instruments. It is shown that the distribution of 85.5 Mc/s radiation on days when the angular separation is less than 10 solar radii is not consistent with a symmetrical scattering process. Better agreement is obtained by postulating the existence of scattering and regular refraction of comparable magnitude. Certain unexplained features of the pencil-beam distributions indicate that large-scale electron irregularities may be important in the scattering and refraction process. Additional evidence is presented for very short-term changes in the transmission properties of the corona.

523.16

4864 RADIO EMISSION FROM THE VELA–PUPPIS REGION. [illegible].Rishbeth.

Austral. J. Phys., Vol. 11, No. 4, 550-63 (Dec., 1958).

The Vela–Puppis region has been surveyed with Mills Cross radio telescopes, and radio isophotes plotted at two wavelengths. Many discrete sources have been observed. Several H II regions have been detected in emission at 3.5 m and in absorption at 15.2 m; the radiation from such objects is of thermal origin. The outstanding feature of this region is a group of strong non-thermal sources near the galactic equator. These are superimposed on an intense belt of radiation along the equator, and this, too, is certainly non-thermal in origin. Some correlation with galactic structure is suggested.

523.16

4865 AN INVESTIGATION OF THE STRONG RADIO SOURCES IN CENTAURUS, FORNAX, AND PUPPIS. K.V.Sheridan.

Austral. J. Phys., Vol. 11, No. 3, 400-8 (Sept., 1958).

Isophotes of three strong southern radio sources have been prepared from observations at a wavelength of 3.5 m with a 50 min pencil-beam system. The two extragalactic sources Centaurus-A and Fornax-A are found to have extensive coronas very much larger than the size of the associated galaxies. Using optical estimates of distance these two sources are shown to have similar spatial extensions and may be physically similar systems. The third source, Puppis-A, may be the remnants of a galactic supernova of type II.

523.16

4866 THE RADIO EMISSION FROM CENTAURUS-A AND FORNAX-A. C.A.Shain.

Austral. J. Phys., Vol. 11, No. 4, 517-29 (Dec., 1958).

Observations of the sources Centaurus-A and Fornax-A at 19.7 Mc/s, with a 1°.4 aerial beam, have been compared with observations at higher frequencies, in particular with Sheridan's 85.8 Mc/s observations (see preceding abstract). There are marked similarities between the sources, in their general appearances, linear dimensions, spectra, and powers radiated at radio frequencies. More detailed discussion of the Centaurus-A observations strongly suggests that the extended component of this source has a spiral structure. It appears to be associated with the bright ellipsoidal part of NGC 5128, but possible association with the dark band cannot be excluded. One plausible interpretation of the data leads to an estimated age of the source of the order of 10^7 years.

523.16

4867 THE ETA CARINAE NEBULA [NGC 3372] AND CENTAURUS A [1354A] NEAR 1400 Mc/s.

I OBSERVATIONS. J.V.Hindman and C.M.Wade.

Austral. J. Phys., Vol. 12, No. 3, 258-69 (Sept., 1959).

The observations were made with a 36 ft transit-mounted paraboloidal aerial and a 21 cm hydrogen-line receiver modified for the reception of continuum radiation. The flux density of the Eta Carinae Nebula near 1400 Mc/s is 5.82×10^{-24} W m^{-2} (c/s)$^{-1}$, with an estimated uncertainty of less than ± 20 per cent. This source appears to be fairly symmetrical, with a strong central condensation. The flux density of Centaurus A is 1.3×10^{-23} W m^{-2} (c/s)$^{-1}$, with an estimated uncertainty of ± 20 per cent. The great angular extent of the object previously found at metre wavelengths is confirmed; at 1400 Mc/s the source cover 7° in declination and about 3° in Right Ascension. The central source associated with NGC 5128 is responsible for about 23 per cent, of the total flux, with the remainder arising in the extended part of the source. There is a well-marked secondary maximum in the extended component at $\alpha_{1950} \approx$ 13hr 21min, $\delta_{1950} \approx -44°.7$.

523.16

4868 RED-SHIFT ABSORPTION SPECTRUM OF THE CYGNUS-A RADIO SOURCE.

R.D.Davies and R.C.Jennison.

Nature (London), Vol. 184, 803-4 (Sept. 12, 1959).

Measurements were made to check the 21 cm hydrogen line absorption spectrum of Cygnus-A reported at 1341 Mc/s by Lilley and McClain. The 250 ft radio-telescope at Jodrell Bank was used in conjunction with a frequency switched receiver. Two separate experiments were performed with the receiver operating in different modes and no absorption was found down to a limit in optical depth of 0.003. The results do not confirm the data of Lilley and McClain. The radio-frequency confirmation of Cygnus-A no longer holds and, moreover, the measurements provide no check that the radio and optical red-shifts are the same. R.D.Davies

523.16

4869 A CATALOGUE OF RADIO SOURCES BETWEEN DECLINATIONS +10° AND −20°.

B.Y.Mills, O.B.Slee and E.R.Hill.

Austral. J. Phys., Vol. 11, No. 3, 360-87 (Sept., 1958).

A catalogue has been prepared of the radio sources observed between declinations +10° and −20°, using the Sydney cross-type radio telescope at a wavelength of 3.5 m: a total of 1159 sources is listed in the area of 3.24 steradians. This supersedes an earlier catalogue of Mills and Slee (Abstr. 5803 of 1957) in portion of the area, but the differences between the two are small. A number of

new identifications with galaxies are suggested, and an analysis made of the statistics of the source distribution. It is concluded that cosmological effects displayed by the distribution, if present, are small. Possibilities are discussed of separating from this distribution the effects of the instrument, the finite angular sizes, and/or the physical clustering of the sources.

523.16

4870 A 21 CM SURVEY OF THE SOUTHERN MILKY WAY. F.J.Kerr, J.V.Hindman and C.S.Gum.
Austral. J. Phys., Vol. 12, No. 3, 270-92 (Sept., 1959).

A study has been made of 21 cm hydrogen-line radiation around the Southern Milky Way, using a beamwidth of 1°.4 and a bandwidth of 40 kc/s (8.5 km/sec). The surveyed strip of the sky was sampled by recording the intensity of the radiation along 41 discrete tracks across the galactic equator, in the longitude range 175°-5° ("old" system of coordinates). The tracks were generally spaced 5° apart in longitude, and were in most cases along lines of constant declination. The range of galactic latitude of the tracks varied from 9° to 1°.5, for reasons connected with the programming of the survey. The observations were taken on a four-channel statically balanced receiver; one run along a track yielded the variation of intensity as a continuous function of sky position at four fixed frequencies. Records were taken at a sufficient number of discrete frequencies to cover the full frequency range of the line. The results are presented in the form of contour diagrams showing the 21 cm intensity along each track as a function of latitude and radial velocity. In addition, line profiles are given for a series of points around the "new" galactic equator. A combination of this survey and that carried out for the northern sky by the Leiden graoup gives a coverage of the whole galactic circle at approximately the same resolution. There is good agreement between the two sets of results in the common range of longitude.

523.16 : 621.396.96

4871 RADAR ECHOES FROM THE SUN. V.R.Eshleman, R.C.Barthle and P.B.Gallagher.
Science, Vol. 131, 329-32 (Feb. 5, 1960).

An account of the Stanford University experiments 1958-9.

523.16

4872 RADIO ECHO OBSERVATIONS OF VENUS. J.V.Evans and G.N.Taylor.
Nature (London), Vol. 184, 1358-9 (Oct. 31, 1959).

Radio echoes were obtained, using the Jodrell Bank radio telescope, at a frequency of 408 Mc/s. An integrating equipment was used to detect echoes below the receiver noise level, and nearly 60 hr useful operating time was obtained at the close approach of the planet in Sept. 1959. The results give a value for the solar parallax of 8.8020 ± 0.0005 seconds of arc, and indicate that the scattering mechanism of Venus is similar to that of the moon.

H.J.A.Chivers

523.16

4873 THE TEMPORAL VARIATION OF THE HEIGHTS OF REFLECTION POINTS OF METEOR TRAILS. A.A.Weiss.
Austral. J. Phys., Vol. 12, No. 2, 116-26 (June, 1959).

Heights of reflection points of over 6000 sporadic meteors measured with a 27 Mc/s combined c.w. radar equipment are analysed. There is no significant seasonal variation in either the mean height or the width of the height distribution. The mean height alone shows a diurnal variation, with maximum height near midnight. A regrouping of the data reveals a dependence of both height parameters on the zenith angle of the apex of the earth's way, with a large scatter. The observations are compared with height distributions computed for a uniform heliocentric distribution of sporadic meteors with uniform heliocentric velocities. Observed and predicted r.m.s. deviations are in agreement. The model reproduces correctly the form of the observed dependence of mean height on the zenith angle of the apex, for zenith angles less than 100°, but the extent of the predicted variation of mean height (12-20 km, depending on the assumptions) far exceeds the observed 3 km. This discrepancy may be reduced considerably by adding to the uniform model distribution a large component of sporadic meteors moving with low speeds in direct orbits whose inclination to the plane of the ecliptic is small.

523.16

4874 RADIO ECHO OBSERVATIONS OF THE GEMINID METEOR STREAM. A.A.Weiss.
Austral. J. Phys., Vol. 12, No. 4, 315-19 (Dec., 1959).

Measurements of radiant coordinates and echo rates from 1952 to 1957 are summarized. A mean radiant of $\alpha = 113.4°$, $\delta = 31.4°$ at solar longitude $\Theta = 260.2°$, a small radiant area, and a markedly asymmetrical distribution of meteors across the stream, with a maximum echo rate at $\Theta = 260.8°$, all agree with northern hemisphere radio echo observations made between 1949 and 1954.

523.16

4875 OBLIQUE ECHOES FROM OVER-DENSE METEOR TRAILS. L.A.Manning.
J. atmos. terrest. Phys., Vol. 14, No. 1-2,82-93 (April, 1959).

Ray paths are computed for waves refracted by meteor trails having a Gaussian radial distribution of ionization density. From the spreading of initially parallel rays as they pass through the trail, a measure of reflected signal intensity versus scattering angle is obtained; the results are presented in polar scattering diagrams, valid in the limit of large trail size. Equivalence theorems are derived relating both intensity and scattering angle for rays incident upon the trail at an arbitrary angle to the intensity and scattering angle for rays incident in the plane normal to the trail. Curves are presented showing the dependence of echo duration on forward-scatter-angle with trail orientation as parameter; it is found that the $\sec^3 \phi$ law developed for under-dense trails applies to over-dense trails only if the plane of propagation contains the trail axis. If not, the effective secant exponent may be as small as 0.3. The theory is compared with McKinley and McNamara's duration measurements (see Abstr. 6313 of 1956). It is found that although the general agreement is satisfactory, the details of their experimental results depend on the way that winds change the trail orientation. The ray theory is also compared with Keitel's wave theory solutions [Proc. Inst. Radio Engrs, Vol. 43, 1481 (1955)] for dense trails of age less than 0.357% of the minimum echo duration, and agreement found for scatter angles up to 155°, thus including all angles available to ground-based stations.

523.16

4876 THEORY OF THE RADIO-ECHO METEOR HEIGHT DISTRIBUTION IN A NON-ISOTHERMAL ATMOSPHERE. A.A.Weiss.
Austral. J. Phys., Vol. 12, No. 1, 54-64 (March, 1959).

The theory of the distribution in height of the echoing points of shower meteors and of sporadic meteors belonging to a homogeneous velocity group, is extended to the case of a model atmosphere in which the scale height is a linear function of height. The mean and the r.m.s. deviation from the mean of the height distribution in this atmosphere are obtained in terms of tabulated functions, and the dependence of these parameters upon the scale height gradient is evaluated. Neither parameter varies strongly with the scale height gradient unless the incident meteors include a large proportion of massive particles. Experimental cut-off and the approximations made in the formulation of the theory limit the accuracy with which atmospheric scale height and density can be determined from observed heights of sporadic meteors.

523.16

4877 THE OHIO STATE UNIVERSITY 360 FT RADIO TELESCOPE. J.D.Kraus.
Nature (London), Vol 184, 669-72 (Aug. 29, 1959).

Describes a radio-telescope of novel design now nearing completion. The reflecting surface is a fixed standing parabola 360 ft long by 70 ft high, figured to operate at a minimum wavelength of 15 cm. At this value the beam width will be 0.1° in right ascension and 0.50° in declination. In front of the parabolic surface at a distance of 500 ft is a flat tiltable surface which deflects the celestial radiation to the main reflector and thence to the receiving equipment at the focus. By adjusting the tilt of the flat surface, different declination regions can be surveyed. A limited degree of tracking in right ascension is possible. A scale model operating at a wavelength of 1.25 cm was used to test the design.

C.Hazard

523.16

4878 A COMPOUND INTERFEROMETER. A.E.Covington.
J. Roy. Astron. Soc. Canada, Vol. 54, No. 1, 17-28 (Feb., 1960).

The formation of a single-lobed, fan-shaped receiving pattern for a radio telescope has been accomplished by combining several individual interference patterns. The aerial described is 600 ft long (185 m), forms a pattern 2 degrees N–S by 1.2 minutes E–W at an operating wavelength of 10 cm, and is used for solar noise

occasionally reversing in sign. On Aug. 18, 1959, the radiation was nearly completely polarized and the noise-storm bursts had a bandwidth of about 2 Mc/s. The total lifetime of a burst was about 2-3 sec and the drift rate was 2-4 Mc/s per second. R.D.Davies

523.16

4860 THE RADIO CONTINUUM RADIATION FROM THE GALAXY. B.Y.Mills.

Publ. Astron. Soc. Pacific, Vol. 71, 267-91 (Aug., 1959).

A review of present knowledge of the origin and distribution of radio emission from the Galaxy. The radiation arises in a thermal component associated with H II regions and a non-thermal one which appears to have three basic divisions, (1) an extensive component of small axial ratio called the "corona" or "halo", (2) a brighter component confined to the galactic plane and concentrated towards the centre of the Galaxy, (3) a population of intense sources concentrated about the Galactic plane. After discussing the mechanism of synchrotron radiation which is accepted as the most probable mechanism for the generation of the non-thermal emission the distribution of these components is considered in more detail. C.Hazard

523.16

4861 A PENCIL-BEAM SURVEY OF THE GALACTIC PLANE AT 3.5 m. E.R.Hill, O.B.Slee and B.Y.Mills.

Austral. J. Phys., Vol. 11, No. 4, 530-49 (Dec., 1958).

A survey has been made of the galactic plane region from $l = 223°$ through the galactic centre to $l = 13°$ between $b = +4°$ and $-6°$ using the 3.5 m wavelength cross-type aerial (beamwidth 50 min of arc) near Sydney. Contour diagrams of brightness temperature have been prepared. The preparation of contours is described in detail, and a detailed discussion of the accuracy of the temperatures is given.

523.16

4862 ON THE RADIO EMISSION OF HYDROGEN NEBULAE. C.M.Wade.

Austral. J. Phys., Vol. 11, No. 3, 388-99 (Sept., 1958).

The interpretation of radio-frequency observations of H II regions is discussed with particular regard for the possible effects of random variations in the electron density and electron temperature through the nebulae. It is shown that such variations serve to alter the optical depth and that the conventional definition of the "emission measure" requires modification if it is to be considered an observable quantity. The radio emission of Strömgren spheres is discussed, and a means of determining their electron temperatures is described. An empirical method for the determination of Strömgren's constant defining the ionized volume as a function of the spectral type and luminosity of the exciting star is described.

523.16

4863 OCCULTATIONS OF THE CRAB NEBULA BY THE SOLAR CORONA IN JUNE 1957 AND 1958.

O.B.Slee.

Austral. J. Phys., Vol. 12, No. 2, 134-56 (June, 1959).

A description is given of some observations of the occultations of the Crab nebula by the solar corona in June 1957 and 1958, obtained with pencil-beam, fan-beam, and interferometer-type instruments. It is shown that the distribution of 85.5 Mc/s radiation on days when the angular separation is less than 10 solar radii is not consistent with a symmetrical scattering process. Better agreement is obtained by postulating the existence of scattering and regular refraction of comparable magnitude. Certain unexplained features of the pencil-beam distributions indicate that large-scale electron irregularities may be important in the scattering and refraction process. Additional evidence is presented for very short-term changes in the transmission properties of the corona.

523.16

4864 RADIO EMISSION FROM THE VELA–PUPPIS REGION. [illegible].Rishbeth.

Austral. J. Phys., Vol. 11, No. 4, 550-63 (Dec., 1958).

The Vela–Puppis region has been surveyed with Mills Cross radio telescopes, and radio isophotes plotted at two wavelengths. Many discrete sources have been observed. Several H II regions have been detected in emission at 3.5 m and in absorption at 15.2 m; the radiation from such objects is of thermal origin. The outstanding feature of this region is a group of strong non-thermal sources near the galactic equator. These are superimposed on an intense belt of radiation along the equator, and this, too, is certainly non-thermal in origin. Some correlation with galactic structure is suggested.

523.16

4865 AN INVESTIGATION OF THE STRONG RADIO SOURCES IN CENTAURUS, FORNAX, AND PUPPIS. K.V.Sheridan.

Austral. J. Phys., Vol. 11, No. 3, 400-8 (Sept., 1958).

Isophotes of three strong southern radio sources have been prepared from observations at a wavelength of 3.5 m with a 50 min pencil-beam system. The two extragalactic sources Centaurus-A and Fornax-A are found to have extensive coronas very much larger than the size of the associated galaxies. Using optical estimates of distance these two sources are shown to have similar spatial extensions and may be physically similar systems. The third source, Puppis-A, may be the remnants of a galactic supernova of type II.

523.16

4866 THE RADIO EMISSION FROM CENTAURUS-A AND FORNAX-A. C.A.Shain.

Austral. J. Phys., Vol. 11, No. 4, 517-29 (Dec., 1958).

Observations of the sources Centaurus-A and Fornax-A at 19.7 Mc/s, with a 1°.4 aerial beam, have been compared with observations at higher frequencies, in particular with Sheridan's 85.8 Mc/s observations (see preceding abstract). There are marked similarities between the sources, in their general appearances, linear dimensions, spectra, and powers radiated at radio frequencies. More detailed discussion of the Centaurus-A observations strongly suggests that the extended component of this source has a spiral structure. It appears to be associated with the bright ellipsoidal part of NGC 5128, but possible association with the dark band cannot be excluded. One plausible interpretation of the data leads to an estimated age of the source of the order of 10^7 years.

523.16

4867 THE ETA CARINAE NEBULA [NGC 3372] AND CENTAURUS A [1354A] NEAR 1400 Mc/s.

I OBSERVATIONS. J.V.Hindman and C.M.Wade.

Austral. J. Phys., Vol. 12, No. 3, 258-69 (Sept., 1959).

The observations were made with a 36 ft transit-mounted paraboloidal aerial and a 21 cm hydrogen-line receiver modified for the reception of continuum radiation. The flux density of the Eta Carinae Nebula near 1400 Mc/s is 5.82×10^{-24} W m^{-2} (c/s)$^{-1}$, with an estimated uncertainty of less than ± 20 per cent. This source appears to be fairly symmetrical, with a strong central condensation. The flux density of Centaurus A is 1.3×10^{-23} W m^{-2} (c/s)$^{-1}$, with an estimated uncertainty of ± 20 per cent. The great angular extent of the object previously found at metre wavelengths is confirmed; at 1400 Mc/s the source cover 7° in declination and about 3° in Right Ascension. The central source associated with NGC 5128 is responsible for about 23 per cent, of the total flux, with the remainder arising in the extended part of the source. There is a well-marked secondary maximum in the extended component at $\alpha_{1950} \approx$ 13hr 21min, $\delta_{1950} \approx -44°.7$.

523.16

4868 RED-SHIFT ABSORPTION SPECTRUM OF THE CYGNUS-A RADIO SOURCE.

R.D.Davies and R.C.Jennison.

Nature (London), Vol. 184, 803-4 (Sept. 12, 1959).

Measurements were made to check the 21 cm hydrogen line absorption spectrum of Cygnus-A reported at 1341 Mc/s by Lilley and McClain. The 250 ft radio-telescope at Jodrell Bank was used in conjunction with a frequency switched receiver. Two separate experiments were performed with the receiver operating in different modes and no absorption was found down to a limit in optical depth of 0.003. The results do not confirm the data of Lilley and McClain. The radio-frequency confirmation of Cygnus-A no longer holds and, moreover, the measurements provide no check that the radio and optical red-shifts are the same. R.D.Davies

523.16

4869 A CATALOGUE OF RADIO SOURCES BETWEEN DECLINATIONS +10° AND −20°.

B.Y.Mills, O.B.Slee and E.R.Hill.

Austral. J. Phys., Vol. 11, No. 3, 360-87 (Sept., 1958).

A catalogue has been prepared of the radio sources observed between declinations +10° and −20°, using the Sydney cross-type radio telescope at a wavelength of 3.5 m: a total of 1159 sources is listed in the area of 3.24 steradians. This supersedes an earlier catalogue of Mills and Slee (Abstr. 5803 of 1957) in portion of the area, but the differences between the two are small. A number of

new identifications with galaxies are suggested, and an analysis made of the statistics of the source distribution. It is concluded that cosmological effects displayed by the distribution, if present, are small. Possibilities are discussed of separating from this distribution the effects of the instrument, the finite angular sizes, and/or the physical clustering of the sources.

523.16

4870 A 21 CM SURVEY OF THE SOUTHERN MILKY WAY. F.J.Kerr, J.V.Hindman and C.S.Gum.

Austral. J. Phys., Vol. 12, No. 3, 270-92 (Sept., 1959).

A study has been made of 21 cm hydrogen-line radiation around the Southern Milky Way, using a beamwidth of 1°.4 and a bandwidth of 40 kc/s (8.5 km/sec). The surveyed strip of the sky was sampled by recording the intensity of the radiation along 41 discrete tracks across the galactic equator, in the longitude range 175°-5° ("old" system of coordinates). The tracks were generally spaced 5° apart in longitude, and were in most cases along lines of constant declination. The range of galactic latitude of the tracks varied from 9° to 1°.5, for reasons connected with the programming of the survey. The observations were taken on a four-channel statically balanced receiver; one run along a track yielded the variation of intensity as a continuous function of sky position at four fixed frequencies. Records were taken at a sufficient number of discrete frequencies to cover the full frequency range of the line. The results are presented in the form of contour diagrams showing the 21 cm intensity along each track as a function of latitude and radial velocity. In addition, line profiles are given for a series of points around the "new" galactic equator. A combination of this survey and that carried out for the northern sky by the Leiden graoup gives a coverage of the whole galactic circle at approximately the same resolution. There is good agreement between the two sets of results in the common range of longitude.

523.16 : 621.396.96

4871 RADAR ECHOES FROM THE SUN. V.R.Eshleman, R.C.Barthle and P.B.Gallagher.

Science, Vol. 131, 329-32 (Feb. 5, 1960).

An account of the Stanford University experiments 1958-9.

523.16

4872 RADIO ECHO OBSERVATIONS OF VENUS. J.V.Evans and G.N.Taylor.

Nature (London), Vol. 184, 1358-9 (Oct. 31, 1959).

Radio echoes were obtained, using the Jodrell Bank radio telescope, at a frequency of 408 Mc/s. An integrating equipment was used to detect echoes below the receiver noise level, and nearly 60 hr useful operating time was obtained at the close approach of the planet in Sept. 1959. The results give a value for the solar parallax of 8.8020 ± 0.0005 seconds of arc, and indicate that the scattering mechanism of Venus is similar to that of the moon.

H.J.A.Chivers

523.16

4873 THE TEMPORAL VARIATION OF THE HEIGHTS OF REFLECTION POINTS OF METEOR TRAILS. A.A.Weiss.

Austral. J. Phys., Vol. 12, No. 2, 116-26 (June, 1959).

Heights of reflection points of over 6000 sporadic meteors measured with a 27 Mc/s combined c.w. radar equipment are analysed. There is no significant seasonal variation in either the mean height or the width of the height distribution. The mean height alone shows a diurnal variation, with maximum height near midnight. A regrouping of the data reveals a dependence of both height parameters on the zenith angle of the apex of the earth's way, with a large scatter. The observations are compared with height distributions computed for a uniform heliocentric distribution of sporadic meteors with uniform heliocentric velocities. Observed and predicted r.m.s. deviations are in agreement. The model reproduces correctly the form of the observed dependence of mean height on the zenith angle of the apex, for zenith angles less than 100°, but the extent of the predicted variation of mean height (12-20 km, depending on the assumptions) far exceeds the observed 3 km. This discrepancy may be reduced considerably by adding to the uniform model distribution a large component of sporadic meteors moving with low speeds in direct orbits whose inclination to the plane of the ecliptic is small.

523.16

4874 RADIO ECHO OBSERVATIONS OF THE GEMINID METEOR STREAM. A.A.Weiss.

Austral. J. Phys., Vol. 12, No. 4, 315-19 (Dec., 1959).

Measurements of radiant coordinates and echo rates from 1952 to 1957 are summarized. A mean radiant of $\alpha = 113.4°$, $\delta = 31.4°$ at solar longitude $\Theta = 260.2°$, a small radiant area, and a markedly asymmetrical distribution of meteors across the stream, with a maximum echo rate at $\Theta = 260.8°$, all agree with northern hemisphere radio echo observations made between 1949 and 1954.

523.16

4875 OBLIQUE ECHOES FROM OVER-DENSE METEOR TRAILS. L.A.Manning.

J. atmos. terrest. Phys., Vol. 14, No. 1-2,82-93 (April, 1959).

Ray paths are computed for waves refracted by meteor trails having a Gaussian radial distribution of ionization density. From the spreading of initially parallel rays as they pass through the trail, a measure of reflected signal intensity versus scattering angle is obtained; the results are presented in polar scattering diagrams, valid in the limit of large trail size. Equivalence theorems are derived relating both intensity and scattering angle for rays incident upon the trail at an arbitrary angle to the intensity and scattering angle for rays incident in the plane normal to the trail. Curves are presented showing the dependence of echo duration on forward-scatter-angle with trail orientation as parameter; it is found that the $\sec^2 \phi$ law developed for under-dense trails applies to over-dense trails only if the plane of propagation contains the trail axis. If not, the effective secant exponent may be as small as 0.3. The theory is compared with McKinley and McNamara's duration measurements (see Abstr. 6313 of 1956). It is found that although the general agreement is satisfactory, the details of their experimental results depend on the way that winds change the trail orientation. The ray theory is also compared with Keitel's wave theory solutions [Proc. Inst. Radio Engrs, Vol. 43, 1481 (1955)] for dense trails of age less than 0.357% of the minimum echo duration, and agreement found for scatter angles up to 155°, thus including all angles available to ground-based stations.

523.16

4876 THEORY OF THE RADIO-ECHO METEOR HEIGHT DISTRIBUTION IN A NON-ISOTHERMAL ATMOSPHERE. A.A.Weiss.

Austral. J. Phys., Vol. 12, No. 1, 54-64 (March, 1959).

The theory of the distribution in height of the echoing points of shower meteors and of sporadic meteors belonging to a homogeneous velocity group, is extended to the case of a model atmosphere in which the scale height is a linear function of height. The mean and the r.m.s. deviation from the mean of the height distribution in this atmosphere are obtained in terms of tabulated functions, and the dependence of these parameters upon the scale height gradient is evaluated. Neither parameter varies strongly with the scale height gradient unless the incident meteors include a large proportion of massive particles. Experimental cut-off and the approximations made in the formulation of the theory limit the accuracy with which atmospheric scale height and density can be determined from observed heights of sporadic meteors.

523.16

4877 THE OHIO STATE UNIVERSITY 360 FT RADIO TELESCOPE. J.D.Kraus.

Nature (London), Vol 184, 669-72 (Aug. 29, 1959).

Describes a radio-telescope of novel design now nearing completion. The reflecting surface is a fixed standing parabola 360 ft long by 70 ft high, figured to operate at a minimum wavelength of 15 cm. At this value the beam width will be 0.1° in right ascension and 0.50° in declination. In front of the parabolic surface at a distance of 500 ft is a flat tiltable surface which deflects the celestial radiation to the main reflector and thence to the receiving equipment at the focus. By adjusting the tilt of the flat surface, different declination regions can be surveyed. A limited degree of tracking in right ascension is possible. A scale model operating at a wavelength of 1.25 cm was used to test the design.

C.Hazard

523.16

4878 A COMPOUND INTERFEROMETER. A.E.Covington.

J. Roy. Astron. Soc. Canada, Vol. 54, No. 1, 17-28 (Feb., 1960).

The formation of a single-lobed, fan-shaped receiving pattern for a radio telescope has been accomplished by combining several individual interference patterns. The aerial described is 600 ft long (185 m), forms a pattern 2 degrees N–S by 1.2 minutes E–W at an operating wavelength of 10 cm, and is used for solar noise

observations. Preliminary interpretations of some of the scanning curves of the solar disk suggest that the E–W extent of the radio emissive regions associated with the sun-spots is seldom smaller than 1.5 minutes of arc.

523.3

4879 QUESTION OF THE EXISTENCE OF A LUNAR MAGNETIC FIELD. M.Neugebauer.

Phys. Rev. Letters, Vol. 4, No. 1, 6-8 (Jan. 1, 1960).

A note, pointing out that the Russian magnetometer measurements from their lunar-impact rocket, which gave no evidence for a lunar magnetic field greater than 6×10^{-3} gauss just prior to impact, are not in themselves sufficient evidence for assuming that the surface magnetic field of the moon, if it exists, is weaker than this amount. Solar corpuscular radiation, deflected in any field on the sunlit hemisphere of the moon would create a current having a magnetic field which would tend to cancel the main field above the surface. A simplified quantitative model is given. G.M.Brown

523.4

4880 PHOTOMETRIC MEASUREMENTS OF SATURN AND OF ITS RING. H.Camichel.

Ann. Astrophys., Vol. 21, No. 5, 231-42 (Sept.-Oct., 1959). In French.

The results of photometric measurements made on photographs of Saturn obtained at the Pic du Midi Observatory since 1943. They give the brightness of the three rings and of the Saturn belts, the brightness of the equatorial zone being taken as unity. It is found that the brightness of B decreases with its aperture; there are also brightness variations along the rings.

523.5

4881 THE DECELERATION OF METEORS DURING THEIR PASSAGE THROUGH THE EARTH'S ATMOSPHERE. F.Verniani.

Nuovo Cimento, Vol. 14, No. 5, 938-42 (Dec. 1, 1959).

The deceleration of meteors is computed theoretically as a function of the characteristic quantities of evaporation, in particular, of velocity. It is shown that for over three quarters of all meteors, the deceleration increases until the end of the evaporation, and that, at the point of maximum rate of evaporation, the deceleration, as a first approximation, may be assumed the same for all meteors.

523.5

4882 POTASSIUM AS A REACTION PRODUCT OF COSMIC RADIATION IN IRON METEORITES. H.Voshage and H.Hintenberger.

Z. Naturforsch., Vol. 14A, No. 9, 828-38 (Sept., 1959). In German.

Nuclear reactions (spallation, fission, etc.) are induced in meteorites under the bombarding action of cosmic radiation. Examination of the products, both "short"- and "long"-lived, of such reactions in a given meteorite permits an assessment of the time integral of the cosmic-ray flux through which it has passed, so if the flux itself is known independently the meteorite's age can be inferred. The proportions of K^{39}, K^{40} and K^{41} in four meteorite samples were determined mass-spectrometrically, and ages not less than 10^8 yr inferred. Details are given of the experimental set-up, which must be capable of measuring isotopic concentrations of less than one part in 10^5. J.W.Gardner

523.5

4883 ESTIMATION OF URANIUM IN METEORITES BY MEANS OF NEUTRON ACTIVATION VIA THE MASS 133 AND 135 ISOTOPES OF XENON. H.König and H.Wänke.

Z. Naturforsch., Vol. 14a, No. 10, 866-9 (Oct., 1959). In German.

The uranium content of 16 meteorites was estimated by the measurement of the concentration of xenon isotopes 133 and 135 following fission of uranium 235. It is shown that with one exception all chondrites have a constant uranium content of $\sim 10^{-6}$% by weight, whereas the uranium content of achondrites shows strong variations. The mean of the concentration ratio Th : U in stone meteorites is ~ 3.46. S.J.St-Lorant

523.5 : 539.16

XENON ISOTOPIC COMPOSITION IN A STONE METEORITE.

See Abstr. 4041

523.5

4884 ARGON 39 PRODUCED BY COSMIC RAYS IN IRON METEORITES. H.Wänke and E.Vilcsek.

Z. Naturforsch., Vol. 14a, No. 11, 929-34 (Nov., 1959). In German.

Describes the separation and estimation of argon 39 in three ferrous meteorites. The argon decay rate of Treysa was found to be 0.36 ± 0.02 decays/kg sec, and its age 6.0×10^8 years. The negative results for the other two meteorites, Carbo and Clark County indicate that they must have fallen more than 10^9 years ago. It is concluded that the intensity of cosmic-ray particles with an energy exceeding 1 BeV is $I_0 = 0.25 \pm 0.07$ particles cm^{-1} sec^{-1} $sterad.^{-1}$ S.J.St-Lorant

523.5

4885 THE TRITIUM–HELIUM AND THE POTASSIUM–ARGON AGE OF THE "RAMSDORF" METEORITE. K.Goebel, P.Schmidlin and J.Zähringer.

Z. Naturforsch, Vol. 14a, No. 11, 996-8 (Nov., 1959). In German.

The age of the meteorite as determined by the tritium and potassium content measurement is found to be 2 to 3 orders of magnitude lower (4×10^6 and 370×10^6 years respectively) than the usual age ($\sim 10^8 - 10^9$ years) of chondritic meteorites. It is suggested that a correction for the loss of gas by diffusion through the rather porous material must be made to account for this discrepancy. S.J.St-Lorant

523.6

4886 SPECTRUM OF THE COMET Mrkos (1957d) IN THE NEAR INFRARED. J.Dufay and P.Swings.

Ann. Astrophys., Vol. 21, No. 5, 260-72 (Sept.-Oct., 1958). In French.

Spectrograms were taken in the region of 8 000 A; their resolution is higher than those hitherto obtained. A triple structure is observed in the emissions near 7 900 and 8 100 A. The assignment of these emissions to the (2-0) and (3-1) transitions of the red system of CN is now certain. Photometric measurements show that these bands of the red system of CN are excited by a fluorescence mechanism.

523.74

4887 THE DYNAMIC CONSTITUTION OF THE OUTER LAYER OF THE SUN. I. ROTATION, MERIDIONAL CURRENTS, ACTIVITY. J.Wasiutynski.

Ann. Astrophys., Vol. 21, No. 3, 119-36 (May-June, 1958).

The hypothesis that an extensive outer layer in the sun is gravitationally unstable does not rest on a firm foundation, and it appears that rotation must play an essential role in generating convection in this layer. Rotational instability must arise as a consequence of an outer layer whose rotation is determined by the Jeans' effect being accelerated by an inner layer which rotates uniformly due to magnetic fields surviving at greater depths and to gravitational instability periodically arising there. The equatorial acceleration of the sun can be explained on the assumption that the common boundary of the two layers is situated at a depth of about 40 000 km below the photosphere. The same hypothesis leads to a quantitative explanation of the meridional drift of sunspots, and to an explanation of the variation of this drift and the variation of the equatorial acceleration with the solar cycle, as well as of certain features of the solar activity.

523.74

4888 THE DYNAMIC CONSTITUTION OF THE OUTER LAYER OF THE SUN. II. DIFFUSION AND CHEMICAL STRATIFICATION. J.Wasiutynski.

Ann. Astrophys., Vol. 21, No. 3, 137-50 (May-June, 1958).

No large-scale currents, except the Eddington currents, probably existed in the outer layer of the sun in primeval times. Under these conditions, helium and the heavier elements must have originally escaped from the outer layer of the sun, so that in a period of the order of 2.5×10^9 years a sharply defined (about 40 000 km thick) outer hydrogen layer was formed.

523.74

4889 THE DYNAMIC CONSTITUTION OF THE OUTER LAYER OF THE SUN. III. RECURRENCE OF DEAP-SEATED CONVECTION AND THE ICE AGES. J.Wasiutynski.

Ann. Astrophys., Vol. 21, No. 4, 169-85 (July-Aug., 1958).

The diffusion of helium and the heavier elements inwards in the sun must be periodically checked by convection arising beneath the bottom of the outer hydrogen layer and causing the solar material to be mixed again. The situation of the upper boundary of the convective layer, i.e. of the bottom of the hydrogen layer, depends on

the value which the magnetic intensity had at the time of primary diffusion in the sun. The boundary lies at a depth of about 40 000 km if at the epoch when convection for the first time started in the sun the magnetic intensity at this level was of the order of a few gauss. Diffusion and mixing must be cyclical, the period (about 2.5×10^8 years) being apparently the same as the great climatic period in the history of the earth. The influence of mixing on the solar radiation is of the same general kind as required for the explanation of the great ice ages. If the deep-seated magnetic field is regenerated by convection and then decays, its intensity in the periods of convection is of the right order of magnitude to account for the sunspot fields.

523.74

4890 THE EFFECT OF THE CURVATURE [OF SOLAR ATMOSPHERIC LAYERS] ON THE INTERPRETATION OF THE DARKENING OF THE SOLAR DISK. P.Proisy.
Ann. Astrophys., Vol. 21, No. 3, 151-61 (May-June, 1958). In French.

523.74

4891 HIGH RESOLUTION OBSERVATIONS OF THE GRANULAR STRUCTURE OF SUNSPOT UMBRAE. R.J.Bray and R.E.Loughhead.
Austral. J. Phys., Vol. 12, No. 4, 320-6 (Dec., 1959).

High-resolution photographs have confirmed the existence of an umbral granulation, resembling the photospheric granulation but differing in regard to lifetime and cell size. Bright structures in the form of "loops" are also seen. Quite apart from the granulation, the intensity contours of spot umbrae show a detailed and complex structure.

523.74

4892 CORRELATION BETWEEN THE INTENSITY OF THE UMBRA OF SUNSPOTS AND ENHANCED RADIATION ON 200 Mc/s. P.Maltby.
Nature (London), Vol. 184, 1391 (Oct. 31, 1959).

Simultaneous measurements have been made of the relative intensity of the umbra of sunspots with a pinhole photometer in three wavelength regions, and of enhanced solar radiation on 200 Mc/s. Although there is only a slight connection between noise activity of sunspots and areas of spots, a high correlation is found between darkness of the umbra and noise activity. Results indicate that the intensity of the umbra must be smaller than a certain threshold value in order to show noise activity. G.M.Brown

523.74

4893 POLARIZATION OF THE LIGHT FROM SUNSPOTS. J.L.Leroy.
C.R. Acad. Sci. (Paris), Vol. 249, No. 23, 2492-4 (Dec. 9, 1959). In French.

During June-July, 1959, 2500 observations of the polarization of sunlight in the neighbourhood of visible spot groups were made with a Dollfus photoelectric polarimeter (Abstr. 6574 of 1958). All the spot regions observed showed weak polarization, the proportion of plane-polarized light being ~ 0.2%. No significant effect of wavelength was found from measures made in ultraviolet, blue, green, and yellow light. In the vicinity of any given spot the amount of polarization is found to vary with time, and with the evolution of the sunspot. Small, isolated spots often show two well-defined zones of opposite polarization (in planes parallel, and perpendicular to the solar radius passing through the sunspot). Short-period changes in the amount, and direction of polarization are often found with times varying from several minutes to a few hours. The polarization pattern associated with a particular spot appears unrelated to its position on the solar disk. D.R.Barber

523.74

4894 POLARIZATION OF LIGHT AT THE EDGE OF THE SOLAR DISK. A.Dollfus and J.L.Leroy.
C.R. Acad. Sci. (Paris), Vol. 250, No. 4, 665-7 (Jan. 25, 1960). In French.

A weak polarization was detected near the solar limb over an angular distance of ~ 5 minutes of arc. Its maximum (limb) amplitude varied from ~ 0.09% at λ = 4100 A to ~ 0.03% at λ = 6000 A. The presence of faculae diminished the polarization; whilst in the vicinity of bright limb prominences the percentage polarization was slightly enhanced. D.R.Barber

523.75

4895 SOME PROPERTIES OF SOLAR CORONAL JETS OBSERVED IN WHITE LIGHT. A.Dollfus.
C.R. Acad. Sci. (Paris), Vol. 249, No. 25, 2722-4 (Dec. 21, 1959). In French.

Intense luminous jets originating in the lower corona are observed (visually) to persist over active chromospheric regions for days, or even months. They are often associated with certain types of prominence and may be observed up to the vicinity of the poles. They are found also to coincide with active centres of centimetre-wave emission. D.R.Barber

523.75

4896 APPARENT OBSERVATION OF SOLAR CORPUSCULAR CLOUDS BY DIRECT CONTINUOUS-WAVE REFLEXION. J.D.Kraus and W.R.Crone.
Nature (London), Vol. 184, 965-6 (Sept.26, 1959).

This note suggests that a solar corpuscular cloud has been observed directly for the first time. A swept frequency receiver centred on 15 Mc/s produced a record which could be interpreted as the result of a doppler shifted reflection, from a moving ion cloud, of the standard 15 Mc/s W.W.V. transmission. H.J.A.Chivers

523.75

4897 THE INNER SOLAR CORONA DURING JUNE 1959. G.A.Newkirk, G.W.Curtis, D.K.Watson, R.Manning and J.Shelby.
Nature (London), Vol. 184, 1308-9 (Oct. 24, 1959).

Using a K-coronameter, estimates of the coronal electron density have been made. Extrapolation of these figures out to the region responsible for the occultation of the Taurus A radio source can assist in the interpretation of the occultation observations. H.J.A.Chivers

523.75

4898 ASSOCIATION OF RADIO OUTBURSTS WITH SOLAR FLARES. L.D. de Feiter, A.D.Fokker and J.Roosen.
Nature (London), Vol. 184, 805-6 (Sept. 12, 1959).

Using the worldwide flare patrol coverage of the I.G.Y., an analysis is made of the relation between flare types and the probability of radio outbursts. Class 3 flares are commonly associated with a radio outburst but this is not so for Class 1 flares. It appears that Class 1 flares which have a definite time of commencement are more likely to be accompanied by a radio event than other Class 1 flares. H.J.A.Chivers

523.75

4899 DISTRIBUTION OF FLARES ON THE SOLAR DISK ASSOCIATED WITH NOISE. L.R.McNarry.
Nature (London), Vol. 184, 806 (Sept. 12, 1959).

Solar radio noise bursts have been associated with specified solar flares for three periods of 1 month during the I.G.Y. There is found to be no east-west asymmetry in the distribution of flares associated with noise bursts, but a marked north-south asymmetry exists. H.J.A.Chivers

523.75 : 523.16

4900 OPTICAL OBSERVATIONS OF THE SOLAR DISTURBANCES CAUSING TYPE II RADIO BURSTS. R.G.Giovanelli and J.A.Roberts.
Austral. J. Phys., Vol. 11, No. 3, 353-9 (Sept., 1958).

Identifications have been established for the solar optical events associated with a number of type II radio bursts. Near or at the limb these have been ejections with velocities exceeding that of sound in the corona. Where the event has been on the disk there has usually been a very bright flare, with some evidence of dark filament activity. In two cases the event was the disappearance (i.e. ejection) of a filament with the subsequent development of flares on either side. Evidence is presented that the fundamental plasma frequency is emitted from events much further from the centre of the disk than expected on the basis of a spherically symmetrical corona.

523.75

4901 THE ERUPTIVE PROMINENCE OF JUNE 15, 1958. T.Cragg.
Publ. Astron. Soc. Pacific, Vol. 17, 307-9 (Aug., 1959).

A large and moderately bright prominence at the sun's W. limb, observed at Mount Wilson from 12 June, 1958 to 15 June, 1958

became eruptive on the last-named date. During the eruptive phase a maximum velocity of 265 km/sec, and a total height of 1.33×10^6 km were attained. No instantaneous accelerations were detected in any region of the erupting mass; if actually present the accelerations were masked by turbulence. D.R.Barber

523.8

4902 AN IMPROVED CALCULATION OF STELLAR VELOCITY PERTURBATIONS. "RELAXATION TIME" PROBLEM. M.Henon.
Ann. Astrophys., Vol. 21, No. 4, 186-216 (July-Aug., 1958). In French.

A new method is used for the computation of the perturbations of a test-star in motion in an homogeneous isotropic stellar population. The influence of close stars is computed by the customary method : succession of single "collisions" to which the two-body formulae are applicable. The influence of far stars is computed by a real perturbation method, taking into account the fact that each star moves very little out of a linear trajectory. It is shown that each method is entirely valid in its own field. The difficulty, ordinarily caused by the divergency of the integrals, disappears. The following are therefore calculated : $< \Delta V_x >$, the mean perturbation of velocity; $< \Delta V_x^2 >$, the longitudinal dispersion; $< \Delta V_y^2 >$, the lateral dispersion (along a simple axis). It is shown that one must distinguish two phases in the evolution of the stellar population : (1) a phase of organization, during which the perturbations are increasing faster than the time; (2) a permanent regime, established after a time T_A, in which the perturbations are increasing proportionally to the time. In the case where the masses of the test star and of the field-stars are of the same order of magnitude, it is established that the expressions given by Chandrasekhar (1942) for the perturbations have to be multiplied by 3/2. The results are immediately valid for the similar problem of totally ionized plasmas.

523.8

4903 THE SCINTILLATION OF THE STARS. H.Elsässer.
Naturwissenschaften, Vol. 47, No. 1, 6-10 (1960). In German.

A review article. The present data on the brightness and directional scintillation of the stars is discussed, in particular their frequency spectrum, their correlation with each other and their variation with telescope aperture, zenith-distance and wind-speed in the atmosphere. It is concluded that the whole atmosphere contributes to the effect and that the present theory of a thin disturbing layer is untenable. P.A.Young

523.87

4904 THE INTERPRETATION OF CONTINUOUS SPECTRA OF STARS. A.Unsöld.
Z. Astrophys., Vol. 49, No. 1, 1-7 (1960). In German.

The relationships found by Chalonge et al.(1956) between short- and long-wave (optical) spectrophotometric gradients, strength of the Fraunhofer lines below 4800 A, and spectral type are confirmed. Comparisons are made of the sub-dwarf stars. HD 19445 and 140283, and of 47 U Ma (Go V) with the Sun. The sub-dwarfs have nearly the same gradient as the G stars; but the metallic abundance (as measured by the line spectrum) is some 200 times smaller. The three-dimensional classification of the sub-dwarf stars is clarified, and the importance of results derived from a comparison of theoretical and observational data is emphasized. D.B.Barber

523.87

4905 THEORETICAL PROBLEMS OF STELLAR CLASSIFICATION. I. THE GROWTH CURVES IN RADIATIVE TRANSFER THEORY. H.van Regemorter.
Ann. Astrophys., Vol. 22, No. 3, 249-85 (May-June, 1959). In French.

The expressions of the equivalent width of a line in the case of a Schuster–Schwarzschild model and in the case of a Milne–Eddington model are found from the exact expression. The concept of mean depth of line formation, defined by Minnaert for the case of weak lines, is generalized for all lines. Thus, from the study of lines of different excitation potentials and of different intensities, it is possible to obtain information on the structure of the atmosphere. Nevertheless, these results concern less the model itself than the turbulence and the deviations from local thermodynamic equilibrium which are found in the layers of line formation.

523.877

4906 NEUTRAL HYDROGEN GAS IN THE TAURUS–ORION REGION OBSERVED WITH A MULTICHANNEL 21 CM LINE RECEIVER. R.X.McGee and J.D.Murray.
Austral. J. Phys., Vol. 12, No. 2, 127-33 (June, 1959).

A multichannel 21 cm hydrogen line receiver has been developed which is capable of producing a complete line profile in the very short time of 2 min. To evaluate the large-scale survey potential of the instrument, the Taurus and Orion regions of approximately 3500 square degrees have been observed with a low-resolution (2.8° between half-power points) paraboloid. The results suggest that a single large cloud or connected association of clouds of neutral hydrogen covers most of the region surveyed.

525

4907 NORTH-SOUTH ASYMMETRY OF THE EARTH'S FIGURE. S.W.Carey with reply by J.A.O'Keefe.
Science, Vol. 130, 978-9 (Oct. 16, 1959).

Perturbations in the orbits of Sputnik 2 and Vanguard 1958 β_2 can be accounted for by a third zonal harmonic in the geoid, i.e. by assuming the earth is slightly pear-shaped. Carey points out that this is consistent with his own theory that the earth is an expanding body, rather than a contracting one. O'Keefe is unable to reconcile the hypothesis with the requirements of fluid equilibrium. G.M.Brown

525

4908 STUDY OF THE EQUATORIAL ORBIT OF AN ARTIFICIAL SATELLITE ASSUMING AN ELLIPSOIDAL EARTH WITH THREE UNEQUAL [EQUATORIAL] AXES. H.Robe.
Bull. Soc. Roy. Sci. Liege, Vol. 28, No. 9-10, 207-21 (Sept.-Oct., 1959). In French.

A discussion of the first perturbations of a satellite orbit in the equatorial plane of the earth. In particular, it is shown that if the period of the orbit is in a commensurable ratio to the period of rotation of the earth, resonance effects arise.

525

4909 THE CONTINUED PROGRESS OF SATELLITE 1958 δ_2 (SPUTNIK III). B.R.May and D.E.Smith.
Nature (London), Vol. 184, 765-7 (Sept. 12, 1959).

Reports observations made from Nov. 1958 - April 1959 inclusive, at the Radio Research Station, Slough, England. The orbit-period of the satellite decreased steadily over this time at a mean rate of rather more than 1.1 sec/day. The decrease probably occurred because the southerly latitude of the perigee (at which maximum drag is experienced) was increasing throughout the interval, resulting in a net increase in the height of the perigee above the earth. Irregularities in the rate of decrease, optical visibility and the reception of radio signals from the satellite are also briefly mentioned. G.D.Sims

525

4910 MAGNETIC DAMPING OF ROTATION OF THE VANGUARD I SATELLITE.
Science, Vol. 131, 355-7 (Feb. 5, 1960).
L.LaPaz (355-6). Explicit integration of integrals of the type basic to comparison of observed and predicted values of the earth's mean total magnetic field reveals an error in the numerical integration recently employed by Wilson (Abstr. 853 of 1960). Correction of this error destroys the satisfactory agreement he found between the value implied by rotational damping and the theoretical value.
R.H.Wilson, Jr. (356-7). Numerical improvement of all parts of previous report, based on later accumulation and rediscussion of data revealed several small random adjustments, including the arithmetical correction discussed by LaPaz. A satisfactory agreement remains of the ground-observed geomagnetic dipole field with that deduced from rotational retardation of the Vanguard I satellite.

525

4911 GEOMAGNETIC ROTATIONAL RETARDATION OF SATELLITE 1959α1 (VANGUARD II). R.H.Wilson,Jr.
Science, Vol. 131, 223-5, (Jan. 22, 1960).

Radio observations made during the battery life of Vanguard II showed that the satellite's rotation was being retarded exponentially at a rapid rate. Precise analysis of electromagnetic couples on the conducting and magnetic parts of the satellite indicates a mean ambient geomagnetic field of 0.158 gauss, and confirms the eddy-current theory previously applied to Vanguard I.

525

4912 DETECTING THE VANGUARD SIGNAL. W.A.Hilton and R.C.Crawford.
Amer. J. Phys., Vol. 26, No. 6, 400-1 (Sept., 1958).

Describes recording of meridian passages of Vanguard satellite using minimum cost detection equipment.

525 : 551.5

DENSITY OF THE UPPER ATMOSPHERE FROM ANALYSIS OF SATELLITE ORBITS. See Abstr. 4787

525

4913 SOME ASPECTS OF ULTRAVIOLET SATELLITE SPECTROSCOPY. L.H.Aller.

Publ. Astron. Soc. Pacific, Vol. 71, 324-9 (Aug., 1959).

Anticipated strengths of stronger lines of astrophysical interest at wavelengths beyond the atmospheric cut-off (2900 A) are discussed with particular reference to Lyman α(1216 A) and lines of Mg II at 2796 and 2803 A. Profiles of these lines are calculated. It is concluded that the H I in the solar system and in interstellar space will seriously affect spectral observations from the beginning of the Lyman series to the soft X-ray region. The Lyman continuum will extinguish all radiation below 912A for the nearest stars, X-radiation from distant stars and gaseous nebulae may be observable.

R.W.Nicholls

525

4914 OBSERVATIONS RELATED TO THE IMPACT OF LUNIK II. G.Fielder.

Nature (London), Vol. 185, 11 (Jan. 2, 1960).

Table of observations gathered from different sources. Attention is drawn to certain inconsistencies.

529

4915 FREQUENCY MEASUREMENT OF STANDARD FREQUENCY TRANSMISSIONS AGAINST CAESIUM-BEAM RESONATOR STANDARD. S.N.Kaira.

Canad. J. Phys., Vol. 37, No. 11, 1328-9 (Nov., 1959).

Tabulates the results of the measurement against a caesium-beam resonator of the frequency of MSF (Rugby, England) 60 kc/s, GBR (Rugby, England) 16 kc/s, KK2XEI (Boulder, Colorado, U.S.A.) 60 kc/s, and WWV (Beltsville, Maryland, U.S.A.) 5 and 10 Mc/s, for August 1959.

E.G.Knowles

PHYSICS

GENERAL

53

4916 A LOOK AT THE "CONTINENTAL CLASSROOM". R.H.Randall.

Amer. J. Phys., Vol. 28, No. 3, 263-9 (March, 1960).

Comprises a set of three independent reviews of the 1958-1959 television presentation of a course in modern physics at about the college freshman level.

53

4917 TESTING FOR PHYSICS ACHIEVEMENT. F.L.Ferris, Jr.

Amer. J. Phys., Vol. 28, No. 3, 269-78 (March, 1960).

Students are influenced strongly by tests, because the tests are to them the basis of rewards for their efforts. Because of this, it is essential that attempts to emphasize methods, as well as subject matter coverage, in physics courses must include the construction of tests that require the student to demonstrate his knowledge of process or method as well as knowledge. Examples of the way in which this has been done in connection with the tests that accompany the Physical Science Study Committee Course are included.

53

4918 ADVANCED PLACEMENT PROGRAM IN PHYSICS. K.H.Moore.

Amer. J. Phys., Vol. 28, No. 3, 279-84 (March, 1960).

The background and growth of the Advanced Placement Programme are discussed. Construction, form, and grading of the examination are described. Some indications of the validity of the examination and acceptance by the colleges are presented. A number of problems still to be solved are posed.

53

4919 NATIONAL SCIENCE FOUNDATION INSTITUTES. E.L.Haenisch.

Amer. J. Phys., Vol. 28, No. 3, 284-6 (March, 1960).

The programme of the National Science Foundation for the support of academic-year, summer, and in-service institutes is summarized and the place of physics in the various institutes is analysed. Details are given as to dates at which proposals must be received, what type of financial help is available to institutions and to participating teachers, and as to the factors that all institutes have in common.

53

4920 COURSE IN PHYSICS FOR STUDENTS OF ARCHITECTURE. C.Williamson.

Amer. J. Phys., Vol. 28, No. 4, 302-5 (April, 1960).

This course was set up for freshmen in architecture whose preparation in science and mathematics may be limited and whose major interests are elsewhere. Because most of the mathematical difficulties in a course in elementary physics appear in mechanics and electricity, it began with sound, light, and heat, postponing mechanics and electricity to the second semester. This unconventional order of presentation has the added advantage that the students find the subjects of sound, light, and heat unexpectedly interesting, and immediately applicable to problems confronting the architect. In this part of the course much of the laboratory work is descriptive and only semiquantitative. The textbook is supplemented with three specially written chapters dealing with the architectural applications of sound, light, and heat, and one more which summarizes the fundamentals of electricity. A reference shelf is set up.

53

4921 ON THE RATIONALE OF LECTURE DEMONSTRATIONS. H.K.Schilling.

Amer. J. Phys., Vol. 28, No. 4, 306-8 (April, 1960).

Among the important, unique contributions lecture demonstrations can make to the effective teaching of physics are the following: (1) they confront the student with nature itself to an extent not possible in the laboratory; (2) they facilitate physical thinking. It is easier to theorize about a phenomenon after one has observed it directly; (3) for most students they provide unexcelled opportunities for observing, and thinking with, a physicist in action in a concrete problem situation; (4) they contribute to historical perspective and understanding, especially through the reenactment of classical observations or experiments, representing momentous discoveries.

53

4922 NONSECRET LABORATORY EXAMINATIONS. J.W.Dewdney and R.W.Christy.

Amer. J. Phys., Vol. 28, No. 4, 399-403 (April, 1960).

Described here are two laboratory examinations of the performance test type whose novelty is that the exact problems have been revealed to students in advance. The results of these examinations are compared with one another and with an earlier examination of the traditional secret sort.

53

4923 MOMENTUM AND CONSERVATION LAWS IN NEWTONIAN AND CANONICAL FORMALISMS. A.Frank and G.L.Trigg.

Amer. J. Phys., Vol. 28, No. 4, 315-16 (April, 1960).

A simple example is given to show how confusion can result from an uncritical transfer of concepts between Newtonian and canonical (Lagrangian or Hamiltonian) formalisms.

53

4924 INTERRELATIONSHIP OF PHYSICAL QUANTITIES. K.G.McNeill.

Amer. J. Phys., Vol. 28, No. 4, 375-7 (April, 1960).

An account is given of the derivation of the Young's modulus, melting point, coefficient of expansion, latent heat, and surface tension of copper and lead from relatively simple ideas of matter. The object is to provide for a student a simple demonstration of the interrelationship of these quantities and thus offset the separation of the various topics sometimes apparent in physics course.

53 : 539.18

4925 VALUE OF THE RYDBERG CONSTANT. W.C.Martin.
Phys. Rev., Vol. 116, No. 3, 654-6 (Nov. 1, 1959).

The spectroscopic measurements of Houston (Abstr. 697 of 1927) and of Chu (Abstr. 1208 of 1939) pertinent to the Rydberg constant are adjusted to a new wavelength value (5015.6779 ± 0.0002 A in air) for the helium line used as a standard by them. This new wavelength, based primarily on recent measurements by the author and by Series and Field (unpublished) replaces the value 5015.675 A accepted by Houston and Chu. The adjustment brings their data into good agreement with spectroscopic observations relative to the cadmium primary standard made by Drinkwater, Richardson, and Williams (Abstr. 763 of 1940). Cohen's conclusion (Abstr. 205 of 1953) that the disagreement of Houston's and Chu's results with those of Drinkwater, et al. was due to a discrepancy in the two standards is thus verified. In addition, a re-appraisal of the data of Chu and of Drinkwater et al. has resulted in a treatment of their observations substantially different from that given by Cohen. The value of the Rydberg constant resulting from a weighted averaging of all the data, $R_\infty = 109737.312 \pm 0.008\ cm^{-1}$, is, however, in excellent agreement with the presently accepted value $109737.309 \pm 0.012\ cm^{-1}$ calculated by Cohen from the data of Drinkwater et al.

53

4926 A SIMPLE UNIFIED FIELD EQUATION AND HYPOTHESIS. A.T.Gresky.
J. Franklin Inst., Vol. 269, No. 2, 105-24 (Feb., 1960).

A unified field equation of force, $F_u = m_e^2c^3/\hbar\alpha_e^2 = m_e^2c^4\epsilon_e/e^2\alpha_e = 0.5m_e^2c^3/E_R\hbar = \hbar cS_e^2/M_b^2m_e^2 = \hbar c/L_m^2 = mr_e^3\omega_e^2\omega_e^2/r_e^3B_a^2 = mr_e\omega_e^3\omega_n^2/\omega_p^2B_a^2 = G/\mu_b^2 = 1.23163 \times 10^{23}$ g cm sec^{-4} G^{-2} = $= 3.981 \times 10^9$ dynes, has been developed from physical quantities such as: electronic mass (m_e); the light velocity constant (c); the angular momentum constant ($\hbar = h/2\pi$); the electronic fine structure constant (α_e); the dielectric constant ($\epsilon_e = 1.0$); the electronic charge (e); the Rydberg energy (E_R); electronic spin ($\hbar/2$); the Bohr magneton (M_b); the electron's "classical radius" (L_m); the earth's mass (m); the moon's average orbital radius (r_e) and angular velocity (ω_e); the rotating earth's angular velocity (ω_E), radius (r_E), polar magnetic intensity (B_a), angular velocity of nutation (ω_n), angular velocity of precession (ω_p); the gravitation constant (G); and a proposed proportionality constant of terrestrial and stellar magnetism ($\mu_b = r_eB_a/m\omega_e = 7.359 \times 10^{-10}$ cm sec G g^{-1} = 1.2943×10^{-9} cm g^{-1}, where one gauss unit is considered equal to 1.7589×10^7 sec^{-1}). The fact that $\hbar c\,\mu_b^2/GL_m^2$ is equal to 1.000 suggests that μ_b and L_m are, respectively, universal constants of macroscopic and submicroscopic particle magnetism, and that the equation F_u prescribes a single universal physical law governing the action-reaction of all particles and fields, whether astronomic or submicroscopic in character.

53

4927 THE LOGICAL FOUNDATIONS OF INVARIANCE PRINCIPLES IN PHYSICS. I. E.Fabri.
Nuovo Cimento, Vol. 14, No. 5, 1130-44 (Dec. 1, 1959).

The logical foundations of invariance principles in physics are discussed with the aim of carrying the physical meaning of the main concepts and operations involved. Care is taken to avoid the use of coordinate systems, which are likely to lead to misunderstandings in the most critical points. The group character of the reference changes is studied, and its relation with the assumption of a postulate of equivalence is shown. The physical consequences of the conclusions of this work for the most usual laws of invariance are to be discussed in a subsequent paper.

53

4928 AUTOMATIC DEVICE FOR RECORDING EXPERIMENTAL RESULTS DIRECTLY ON TELEPRINTER TAPE.
M.M.Winn and K.W.Ogilvie.
Rev. sci. Instrum., Vol. 31, No. 2, 185-7 (Feb., 1960).

A device is described which will record the results of counting experiments directly on teleprinter tape at predetermined intervals.

GRAVITATION . RELATIVITY

530.12

4929 ETHER AND RELATIVITY. G.Builder.
Austral. J. Phys., Vol. 11, No. 3, 279-97 (Sept., 1958).

The relative retardation of clocks, predicted by the restricted theory of relativity, demands the recognition of the causal significance of absolute velocities. This demand is also implied by the relativistic equations of electrodynamics and even by the formulation of the restricted theory itself. The observable effects of absolute accelerations and of absolute velocities must be ascribed to interaction of bodies and physical systems with some absolute inertial system. There is no alternative but to identify this absolute system with the universe. Thus, in the context of physics, absolute motion must be understood to mean motion relative to the universe, and any wider or more abstract interpretation of the "absolute" must be denied. Interaction of bodies and physical systems with the universe cannot be described in terms of Mach's hypothesis, since this is untenable. There is therefore no alternative to the ether hypothesis. It is shown that this is compatible with the restricted theory of relativity and even provides a tenable basis, when taken together with the principle of relativity, for that theory. It is shown that the hypothesis provides a satisfactory and sufficient causal explanation of the predicted relative retardation of clocks, and attention is drawn to its striking pedagogical and heuristic advantages.

530.12

4930 A BRIEF SURVEY OF SOME PROBLEMS IN GRAVITATION. II. V.V.Narlikar.
Bull. Calcutta Math. Soc., Vol. 50, No. 1, 1-5 (March, 1958).
For Pt I, see Abstr. 1017 (1959).

530.12

4931 CERTAIN MATTERS IN RELATION TO THE RESTRICTED THEORY OF RELATIVITY, WITH SPECIAL REFERENCE TO THE CLOCK PARADOX AND THE PARADOX OF THE IDENTICAL TWINS. II. DISCUSSION OF THE PROBLEM OF THE IDENTICAL TWINS. W.F.G.Swann.
Amer. J. Phys., Vol. 28, No. 4, 319-23 (April,1960).

For Pt I, see Abstr. 41 (1960). The problem of the "twins" concerns two twins a and b. With a at rest in S, set b in motion, allow it to travel a certain distance, and then reverse the motion so that it returns to rejoin a. In this problem, acts are performed on b while nothing is done to a. The problem of the effects of imparting motion to an entity is analysed in the light of the discussion in Pt I, and the customary conclusion is established to the effect that, as measured by heartbeats, b ends the journey younger than a. The customary argument which produces the apparent paradox is to the effect that if one takes a stand with b in S', one sees a moving away from b, then reversing its velocity with subsequent return to b, to find that it, a, is now younger than b. It is pointed out that in this second view of the problem there is danger of envisaging a situation entirely different from that of the first problem. The danger lies in supposing that in the frame which accompanies b something is done to a — in the reversal of its velocity. The second view of the matter should recognize that to secure the apparent reversal of velocity of a as seen by b, one should not do something to a from the frame of b, but should do something to b from the frame of b itself. If the discussion is carried out in this manner, no paradox results.

530.12 : 535.22

4932 THE CONSTANCY OF THE VELOCITY OF LIGHT. G.Builder.
Austral. J. Phys., Vol. 11, No. 4, 457-80 (Dec., 1958).

The principle of the constancy of the velocity of light has generally been given a prominent place in discussions of the restricted theory of relativity. Yet lack of any clear and unambiguous statement of the principle has led to its frequently being misunderstood and to its sometimes being adduced as a basis for fallacious conclusions. The principle is discussed from a historical point of view, is carefully analysed, and is stated in a form which seems free from ambiguity. In the context of the restricted theory the "velocity of light" must always be interpreted as "the velocity of light measured in an inertial reference system" and it must be understood that this measured value is the average speed measured over a go-and-return path. The principle can then be stated in the form:

"The principle of relativity precludes any possibility of ascertaining how light is propagated relative to any inertial reference system. Measurements made in inertial reference systems, using the methods of measurement prescribed by the restricted theory, always give the same value c for the speed of light irrespective of the direction of its propagation and irrespective of the motion of its source". Fallacious inferences about the propagation of light, arising out of an incorrect definition of "relative velocity" and out of the incorrect appellation of the relativistic law of transformation of velocities as the "law of addition of velocities" are discussed; and it is shown that the ballistic theory of light is quite incompatible with the restricted theory. It is pointed out that the measurement procedures prescribed by the restricted theory are conventional; failure to recognise this has led many exponents of the restricted theory to assert, without sufficient justification, that these procedures demand a complete revision of the older concepts of space and time.

530.12

4933 AN EXPERIMENT DESIGNED TO VERIFY THE GENERAL THEORY OF RELATIVITY. M.Surdin.
C.R. Acad. Sci. (Paris), Vol. 250, No. 2, 299-301 (Jan. 11, 1960). In French.

It is suggested that maser techniques make it possible to compare the frequencies of clocks at different altitudes on the earth's surface. R.A.Newing

530.12

4934 ON EXPERIMENTAL TESTS OF THE GENERAL THEORY OF RELATIVITY. L.I.Schiff.
Amer. J. Phys., Vol. 28, No. 4, 340-3 (April, 1960).

Explores the extent to which the three "crucial tests" support the full structure of the general theory of relativity, and do not merely verify the equivalence principle and the special theory of relativity, which are well established by other experimental evidence. It is shown how the first-order changes in the periods of identically constructed clocks and the lengths of identically constructed measuring rods can be found without using general relativity, and how the red shift and the deflection of light can be computed from them. Only the planetary orbit precession provides a real test of general relativity. Terrestrial or satellite experiments that would go beyond supplying corroborative evidence for the equivalence principle and special relativity would be extremely difficult to perform, and would, for example, require a frequency standard with an accuracy somewhat better than one part in 10^{18}.

530.12

4935 EÖTVÖS EXPERIMENT AND THE GRAVITATIONAL RED SHIFT. R.H.Dicke.
Amer. J. Phys., Vol. 28, No. 4, 344-7 (April, 1960).

The relation of the results of the Eötvös experiment (1922) to the equivalence principle is discussed. It is asserted that the equivalence principle is not established by the results of the Eötvös experiment. The type of discrepancy discussed could result in an anomalous gravitational red shift. Consequently, contrary to the conclusion of Schiff's article (see preceding abstract), red shift experiments are considered important.

530.12 : 539.12

POSSIBLE LABORATORY METHOD OF DETERMINING THE GRAVITATIONAL RED-SHIFT. See Abstr. 3947-8

530.12 : 539.12

4936 LAGRANGE FUNCTION FOR THE MOTION OF CHARGED PARTICLES IN GENERAL RELATIVITY THEORY. II. S.Bażański.
Acta phys. Polon., Vol. 16, No. 6, 423-33 (1957).

For Pt 1, see Abstr. 6486 (1959). The Lagrangian is given for non-Newtonian equations of motion.

530.12 : 538.3

4937 THE UNIFIED FIELD THEORY OF GRAVITATION AND ELECTRICITY. J.Pachner.
Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 1-2, 70-106 (1959). In German.

In an improved development of the author's modified Einstein–Schrödinger theory, use is made of Infeld's modified Dirac delta function. The equations of motion for the two body problem are derived in a first approximation. The motion of a charged test particle is discussed and the equations are integrated in the case of a static spherically symmetric field. An explicit postulate of the theory is that the field equations shall reduce the Einstein–Maxwell equations in the case of strong gravitational and weak electromagnetic fields, and support is found for the author's identification of g_{ik} with the magnetic field and g_{i4} with the electric field. The heterogeneous Hamiltonian upon which the theory is based involves a scalar constant d which acts as a coupling constant between gravitational and electromagnetic fields. This constant, together with the velocity of light and the gravitational constant, make possible the introduction of a fundamental system of units. The possible relation of this fundamental system to the discrete nature of electric charge is considered. R.A.Newing

QUANTUM THEORY

(Applications of quantum theory to elementary particles and nuclei are included under Nuclear Field Theory)

530.14

4938 ON INVERSIONS OF SPACE AND TIME. J.Rzewuski.
Acta phys. Polon. Vol. 16, No. 6, 435-45 (1957).

The transformation properties of spinors and pseudospinors with respect to inversions of space and time are investigated. In particular, the various possible two-component theories are investigated. A purely geometrical approach to the theorem of Lüders and Pauli is pointed out.

530.14

4939 INTEGRATION IN FUNCTIONAL SPACES AND ITS APPLICATIONS IN QUANTUM PHYSICS.
I.M.Gel'fand and A.M.Yaglom.
J. math. Phys. (New York), Vol. 1, No. 1, 48-69 (Jan.-Feb., 1960).

Translated from Uspekhi Matematicheskikh Nauk, Vol. 11 (Jan.-Feb., 1956), p. 77. A review article, presented at the Third All-Union Conference on the Theory of Probability and its Applications, in Leningrad, May 30 to June 4, 1955, under the title "Methods of the Theory of Random Processes in Quantum Physics".

The article begins with a discussion of Wiener measure, after which the extension is made to the complex measure introduced by Feynman in his formulation of quantum mechanics, and examples are given of the use of these methods in quantum mechanics, quantum field theory, and quantum statistical physics. A comprehensive bibliography of works devoted to the theory and applications of functional integration methods is included.

530.14

4940 TOWARDS A METHOD FOR THE ACCURATE SOLUTION OF THE SCHRÖDINGER WAVE EQUATION IN MANY VARIABLES. I. FORMULATION OF THE METHOD FOR AN EIGENVALUE PROBLEM WITHOUT SYMMETRY CONDITIONS.
I.M.Bassett.
Austral. J. Phys., Vol. 12, No. 4, 430-40 (Dec., 1959).

The aim is to formulate and explore a new method, suitable for use with an electronic digital computer, for the solution of eigenvalue–eignefunction problems in many variables, with the aim of applying the method to the Schrödinger wave equation. In this method, an expression for an eigenfunction F, depending on the variables x, y, ..., z, is sought in the form

$$F = F(x, y, \ldots, z) = \sum_i f_i(x)g_i(y) \ldots h_i(z), \quad \ldots\ldots\ldots\ldots \text{(A)}$$

which is a sum of products of functions of one variable; the functions of one variable are represented numerically, and are determined with the aid of the variation principle, so as to give a "best" representation of F of this form. This may be contrasted with the Rayleigh–Ritz method, in which each term of the series (A) is, apart from a multiplying coefficient, an analytic function determined in advance, only the coefficients being determined by the variation principle. In view of this contrast, it would be expected that the present method would give a more accurate expression for F with a given number of terms, and may therefore be regarded as an attempt to solve the problem of slow convergence of the Rayleigh–Ritz procedure for complex problems. The method is worked out in detail only for the fundamental solution. The stationary condition by which the functions of one variable are determined is shown, subject to

certain reservations, to be a minimum condition, and the convergence of the procedure is discussed. A way is suggested for obtaining an initial estimate of the eigenfunction, for the iterative improvement which the method prescribes.

530.14

4941 TOWARDS A METHOD FOR THE ACCURATE SOLUTION OF THE SCHRÖDINGER WAVE EQUATION IN MANY VARIABLES. II. A SIMPLE NUMERICAL ILLUSTRATION. I.M.Bassett.

Austral. J. Phys., Vol. 12, No. 4, 441-8 (Dec., 1959).

The method described in Pt I is here applied to an eigenvalue problem in two variables

$$\mathcal{H}\,\phi(x,y) = \lambda\phi(x,y).$$

The results show that an accurate estimate of the fundamental eigenvalue (to seven significant figures) and eigenfunction can be obtained for this problem with only four terms in the series expression for ϕ,

$$\phi = \sum_k a_k(x)b_k(y).$$

An application of the Rayleigh–Ritz method to the same problem gives a four-term solution of much lower accuracy. The example shows that the individual functions a_k and b_k are not uniquely determined. It shows that a calculation based on a coarse interval can provide good initial estimates of the $a_k(x)$ and $b_k(y)$ and, moreover, predict the accuracy of the corresponding solution without numerical approximation.

530.14

4942 TOWARDS A METHOD FOR THE ACCURATE SOLUTION OF THE SCHRÖDINGER WAVE EQUATION IN MANY VARIABLES. III. APPLICATION OF THE GENERAL METHOD TO THE WAVE EQUATION WITHOUT SPATIAL SYMMETRY. I.M.Bassett.

Austral. J. Phys., Vol. 12, No. 4, 449-54 (Dec., 1959).

The method of Pt I is applied to the problem of finding the lowest antisymmetric eigenfunction of the wave equation for n electrons without spatial symmetry, and the lowest antisymmetric eigenfunction of given multiplicity. Knowledge of the multiplicity of the ground state is not needed. Theorem 3 of Pt I, which proves the equivalence of the central stationary condition to a minimum condition, is extended to cover the present case.

530.14

4943 ON A GENERALLY COVARIANT QUANTUM THEORY. B.E.Laurent.

Ark. Fys., Vol. 16, Paper 23, 237-45 (1959).

A theory, expressed ab initio a generally covariant form, and satisfying the usual quantum postulates, is outlined. The basis for the theory is the structure of the general coordinate transformation group and a way of representing it introduced by Klein (1955). Various representations of the general coordinate transformation group are discussed. As a particular example, the mixed second-rank tensor density (weight $\frac{1}{2}$) field is treated in some detail due to its possible connection with gravitation.

530.14

4944 INTRODUCTION TO COMPLEX ORBITAL MOMENTA. T.Regge.

Nuovo Cimento, Vol. 14, No. 5, 951-76 (Dec. 1, 1959).

The orbital momentum j, until now considered as an integer discrete parameter in the radial Schrödinger wave-equations, is allowed to take complex values. The purpose of such an enlargement is not purely academic but opens new possibilities in discussing the connection between potentials and scattering amplitudes. In particular it is shown that under reasonable assumptions, fulfilled by most field theoretical potentials, the scattering amplitude at some fixed energy determines the potential uniquely, when it exists. Moreover for special classes of potentials V(x), which are analytically continuable into a function V(z), $z = x + iy$, regular and suitable bounded in $x > 0$, the scattering amplitude has the remarkable property of being continuable for arbitrary negative and large cosine of the scattering angle and therefore for arbitrary large real and positive transmitted momentum. The range of validity of the dispersion relations is therefore much enlarged.

530.14

4945 A REMARK ON THE UNITARITY PROPERTY OF THE SCATTERING OPERATOR. T.Kato and S.T.Kuroda.

Nuovo Cimento, Vol. 14, No. 5, 1102-7 (Dec. 1, 1959).

An example of a scattering system with the following properties is constructed: (1) the unperturbed Hamiltonian possesses no bound states, (2) the wave operators exist and (3) the scattering operator is not unitary.

530.14

4946 ON COULOMB WAVE FUNCTIONS. P.O.M.Olsson.

Ark. Fys., Vol. 15, Paper 10, 131-43 (1959).

Describes the representation of radial Coulomb wave-functions in terms of confluent Appell functions (generalized hypergeometric functions). Various transformations, series expansions and integral representations are given. The domain of convergence appears to be enlarged by the use of these functions. J.Hawgood

530.14

4947 ON TRANSITION MATRIX ELEMENTS BETWEEN STATES IN A COULOMB FIELD. I-II. P.O.M.Olsson.

Ark. Fys, Vol. 15, Paper 13, 159-67; Paper 25, 289-301 (1959).

The expressions for Coulomb wave-functions in terms of generalized hypergeometric (Appell) functions (see preceding abstract) are used in Pt I to derive series expansions of the matrix elements for transitions between bound and non-bound states. The expansions converge for "all physically interesting cases", and they converge fastest for small energies, unlike the usual expansions. In Pt II, the Appell function approach is used for a more general class of matrix elements, those expressible in terms of the hypergeometric functions of several variables (Lauricella function), e.g. the radiative transition matrix elements between states in a Coulomb field. The results in both parts are in a convergent form suitable for automatic computation, being based on recurrence relations. J.Hawgood

STATISTICAL MECHANICS
TRANSFER PROCESSES

530.16

4948 MANY-BODY PROBLEM IN QUANTUM STATISTICAL MECHANICS. V. DEGENERATE PHASE IN BOSE–EINSTEIN CONDENSATION. T.D.Lee and C.N.Yang.

Phys. Rev., Vol. 117, No. 4, 897-920 (Feb. 15, 1960).

The formulation of Pt IV (Abstr. 3458 of 1960) is extended so that it becomes applicable in an interacting system in the presence of a Bose–Einstein degeneracy. This extension is carried out by the introduction of an x-ensemble, which enables one to utilize an Ursell-type expansion even in the presence of a Bose–Einstein degeneracy. The variational principle of the previous paper is also extended. It is proved that in the presence of a Bose–Einstein degeneracy, the average occupation number of a single particle state with momentum p approaches infinity as $p \to 0$. The method is applied to a dilute system of Bose hard spheres.

530.16

4949 NEW POTENTIAL FOR IRREVERSIBLE PROCESSES. P.G.Bergmann and E.Morris.

Ann. Phys., (New York), Vol. 8, No. 2, 266-70 (Oct., 1959).

Two results are reported. If a system is driven by several reservoirs, then two different Gibbsian distributions, both of which obey the Liouville equation with additional stochastic terms, will approach each other in the course of time; a whole class of positive-definite functionals of these two distributions is constructed which decrease monotonically in the course of time. The other result is the construction of a functional of a single distribution, also positive-definite, which tends to zero monotonically in the course of time and which will equal zero only if the distribution is stationary.

530.16

4950 IRREVERSIBILITY IN THE THEORY OF MEASUREMENT. J.Philippot.

Bull. Acad. Roy. Belgique Cl. Sci., Vol. 45, No. 6, 583-90 (1959). In French.

It is shown that the kind of irreversible transformation which is realized in the quantum mechanical process of measurement is

directly related to the class of irreversible processes which appears in the space of angle variables of classical systems because of the frequency dispersion.

530.16

4951 IRREVERSIBILITY IN THE SPACE OF ANGULAR VARIABLES. J.Philippot.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 45, No. 6, 591-4 (1959). In French.

The study of a simple example of irreversible evolution in the space of angle variables permits one to make more precise the meaning of the paradoxes of recurrence and velocity inversion as well as the essential role of the observation scale.

530.16

4952 ON THE CONCEPTS OF FLOW AND PRODUCTION OF ENTROPY AND ON FOURIER'S LAW. M.Roy.
C.R. Acad. Sci. (Paris), Vol. 250, No. 1, 35-8 (Jan. 4, 1960). In French.

530.16

4953 SLIGHTLY IRREVERSIBLE TRANSFORMATIONS AND THE ONSAGER RELATIONS. THERMAL EXCHANGES AND PASSIVE RESISTANCES. M.Roy.
C.R. Acad. Sci. (Paris), Vol. 250, No. 4, 639-42 (Jan. 25, 1960). In French.

530.16

4954 PROPERTIES OF MACROSCOPIC OBSERVABLES AND QUANTUM ERGODIC THEORY. R.Jancel.
C.R. Acad. Sci. (Paris), Vol. 250, No. 4, 671-3 (Jan. 25, 1960). In French.

Results recently obtained along the lines of the von Neumann-type quantum statistical ergodic theorem are re-derived. Attention is also drawn to an error in an earlier note by the author (Abstr. 6769 of 1955), in agreement with remarks made by Farquhar and Landsberg (Abstr. 5088 of 1957). P.T.Landsberg

530.16

4955 THE USE OF THE SPHERICAL HARMONICS METHOD IN THE GROUP STUDY OF THE TRANSPORT EQUATION. C.Lo Surdo.
Energia nucleare, Vol. 7, No. 1, 39-52 (Jan., 1960). In Italian.

A general discussion on the use of the spherical harmonics method for the solution of the transport equation with prompt restitution, when no restriction is made either to the geometry of the problem, or to the nature of the scattering function and of the source, or to the completness of the solution in terms of possible independent solutions. From the energetical standpoint use is made of the classical group method, and the matricial formalism is applied systematically; the general solution results in terms of the eigensolutions of two matricial homogeneous equations, with suitable boundary conditions.

530.16

4956 POINCARÉ CYCLES, ERGODICITY, AND IRREVERSIBILITY IN ASSEMBLIES OF COUPLED HARMONIC OSCILLATORS. P.Mazur and E.Montroll.
J. math. Phys. (New York), Vol. 1, No. 1, 70 (Jan.-Feb., 1960).

The transport coefficients (diffusion constant, electrical conductivity, etc.) associated with irreversible processes in an assembly of particles can be expressed as integrals over certain time relaxed correlation functions between small numbers of variables of the assembly. The scattering of slow neutrons is also a measure of time relaxed correlation functions. Irreversibility is a consequence of the vanishing of the correlation coefficients as the relaxation time becomes infinite. On the other hand these coefficients have Poincare cycles so that any value which they take on is repeated an infinite number of times. It is shown that, in the case of fluctuations of $0(N^{-1/2})$ from zero (N being the number of degrees of freedom), the period of Poincare cycles is of the order of the mean period of normal mode vibrations while for fluctuations of a magnitude independent of N the period is of the order of C^N where C is a constant which is greater than 1. The time relaxed correlation coefficients of a pair of particles separated by r lattice spacings decays as $t^{-m/2}$, m being the number of dimensions of the assembly. The statistics of the decay of the momentum of a particle from a preassigned initial value to its equipartition value are discussed.

530.16

4957 FLUCTUATION PHENOMENA AND STOCHASTIC PROCESSES. C.Domb.
Nature (London), Vol. 184, 509-12 (Aug. 15, 1959).

Report of a Physical Society conference, Birkbeck College, March, 1959. The 29 papers presented included discussions on the classification of statistical fluctuations; the fluctuations of macroscopic parameters with applications to stress and strain in crystalline solids; the mathematical properties of stochastic functions with applications to the analysis of experimental data, including the problem of signal detection in the presence of background noise; various random walk problems with applications to percolation processes and multiple scattering in foils. Stochastic problems in radio physics were considered, together with problems connected with sound and sea waves, and with traffic flow. R.A.Newing

530.16

4958 A SIMPLIFIED METHOD OF SOLUTION FOR A RANDOM WALK PROBLEM OF A FEW UNEQUAL STEPS. D.O'Connor.
Acta phys. Polon., Vol. 17, No. 4, 273-9 (1958).

A simplified method is presented for calculating the probability that the amplitude of the resultant vector, formed by the vector addition of a finite number of vectors of known amplitude and random orientation, will lie in a given range. This method is simpler to use for small numbers of vectors unequal in length, than other methods. Recursion formulae are given for calculating the probability functions for assemblages of vectors of equal length.

530.16

4959 HEADS–TAILS STATISTICS FOR TWO PARTIALLY DISTINGUISHABLE COINS. G.Weinreich.
Nature (London), Vol. 184, 1825-6 (Dec. 5, 1959).

Resolves the apparent discrepancy between quantum statistics and the statistics of coin-tossing. "Coins have a multitude of degrees of freedom, and it is this fact which makes them distinguishable in practice". It is, in fact, shown that an "indistinguishability parameter", related to the number of quantum states of a coin, can be defined according to the usual conventions and that it leads correctly to the limiting cases of classical, Bose and Fermi statistics. H.N.V.Temperley

530.16

4960 AN ASYMPTOTIC CAUSALITY REQUIREMENT FOR SYSTEMS WITH CONSTRAINED INPUTS. J.Sucher.
Nuclear Phys., Vol. 14, No. 2, 263-9 (Dec. [2], 1959).

The usual formulation of causality for simple linear systems: "no output before input", may fail to imply that the system kernel $K(\tau)$ is a causal function of the time delay τ, because the class of physically admissible input functions may not contain a complete set of causal signals. An attempt is made to formulate a causality requirement, asymptotic in nature, which overcomes this difficulty. It is found, rather generally, that systems which satisfy this requirement cannot have a finitely acausal kernel. If it could be shown that the kernel cannot be infinitely acausal, the validity of the usual dispersion relations for such systems would be ensured.

530.16 : 539.2

NOTE ON THE "TORON" FORMALISM DEVELOPED BY MONTROLL AND WARD. See Abstr. 4276

530.19

4961 RADIATIVE TRANSFER IN NON-UNIFORM MEDIA. R.G.Giovanelli.
Austral. J. Phys., Vol. 12, No. 2, 164-70 (June, 1959).

The equation of radiative transfer incorporating Eddington's approximation is expressed in a form applicable to an inhomogeneous medium, as

$$\tfrac{1}{3}\nabla^2 J = \frac{1}{3\kappa}\nabla J \cdot \nabla\kappa + \kappa^2(\lambda J - 4\pi S).$$

Here J is the total intensity, κ the attenuation coefficient, λ the ratio of absorption and attenuation coefficients, and S the source function. A study is made of the emission from a simple model inhomogeneous semi-infinite medium, including the relative effects of variations in κ, λ, and S across the surface. Particular attention is drawn to the significance of variations in attenuation coefficient in connection with the appearance of chromospheric granulation.

530.19

4962 RADIATION TRANSFER AND THE POSSIBILITY OF NEGATIVE ABSORPTION IN RADIO ASTRONOMY. R.Q.Twiss.
Austral. J. Phys., Vol. 11, No. 4, 564-79 (Dec., 1958).

Stimulated transitions are relatively enormously more probable at radio than at optical frequencies and it is this which makes it possible for negative absorption to arise at radio wavelengths when the medium will behave like an amplifier to the incident radiation. A necessary condition for the existence of this phenomena is that the kinetic energy distribution $F(\eta)$ of the radiating electrons be markedly non-thermal with an appreciable excess of high energy electrons such that $\delta F/\delta\eta$ is positive over a finite range of the kinetic energy η. However, this condition is not sufficient, since it is shown that an electron gas in which free-free transitions provide the dominant radiation process can never exhibit negative absorption whatever the form of $F(\eta)$, and it is further necessary that the stimulated transition probability should have a maximum at some finite value of the kinetic energy, the most favourable case occurring when this maximum is a sharp one at the value of η at which $\delta F/\delta\eta$ has a positive maximum. These conditions can both be met in principle for the cases in which the dominant radiation process is due (a) to Cherenkov effect, (b) to gyro radiation by non-relativistic electrons, (c) to synchrotron-type radiation by highly relativistic electrons, and it is shown that negative absorption can arise in all these cases; the relevance of these results to radio astronomy is discussed briefly.

530.19

4963 SOME PROBLEMS OF DIFFUSION OF RADIATION. V.V.Sobolev.
Dokl. Akad. Nauk SSSR, Vol. 129, No. 6, 1265-8 (Dec. 21, 1959). In Russian.

Several, seemingly different problems of radiation diffusion can be finally reduced to a solution of integral equation of the same type :

$$B(\tau) = \frac{\lambda}{2}\int_0^\infty [Ei\,|\tau - t| + Ei(\tau + t)]\,B(t)\,dt + g(\tau),$$

where Ei is the logarithmic integral. Three examples of such problems are given (quantum radiation in an absorptive and radiative medium consisting of plane parallel layers of different characteristics; planetary spherical nebula with a central star radiating quanta of energy; point quantum source in an infinite medium) and a method of solution is developed which uses Hilbert and Laplace transforms.
J.K.Skwirzynski

GENERAL MECHANICS

531.1

4964 NEW ASPECTS OF CLASSICAL MECHANICS. I.Prigogine.
Bull.Acad. Roy. Belgique Cl. Sci., Vol. 44, No. 12, 1066-81 (1958). In French.

A formulation of the classical mechanics of systems with many degrees of freedom is based on Liouville's theorem. It is suggested that an analogy with quantum mechanics makes possible the application of recently developed quantum mechanical techniques to classical many-body problems. R.A.Newing

531.22

4965 APPARATUS DRAWINGS PROJECT. REPORT NUMBER 4. AIR SUSPENSION APPARATUS FOR MEASURING THE RESOLUTION OF FORCES. R.G.Marcley.
Amer. J. Phys., Vol. 28, No. 3, 259-62 (March, 1960).

The equipment described is a sailboat model designed for use in an undergraduate student laboratory for the quantitative investigation of the resolution of forces. The "sailboat" floats on a cushion of air to reduce friction to a minimum. The force to be resolved, which may be applied from any horizontal direction, is the "wind", supplied by a high-velocity blower. The experimental error is less than 5%.

531.25

4966 ON THE EFFECT OF PRESCRIBED SHEARING STRESS ON THE PLANE SURFACE OF AN ELASTIC SLAB WITH VARYING MODULUS OF RIGIDITY. P.Choudhury.
Bull. Calcutta Math. Soc., Vol. 51, No. 1, 21-4 (March, 1959).

531.25

4967 STRESSES DUE TO A CONCENTRATED FORCE IN AN INFINITE ELASTIC PARABOLIC PLATE NOT CONTAINING THE FOCUS. M.Mohan.
Bull. Calcutta Math. Soc., Vol. 51, No. 2, 66-72 (June, 1959).

Complex potential functions are used to solve a two dimensional problem for an elastic plate with stress-free parabolic boundary, not containing the focus, under the effect of a concentrated force acting at any point of the plate when the stresses and rotation vanish at infinity. The method leads to the solution of the Hilbert problem.

531.25

4968 STRESS CONCENTRATIONS AROUND A SMALL INCLUSION (FORMED BY THE REVOLUTION OF A CARDIOID ABOUT ITS AXIS) ON THE AXIS OF A CIRCULAR CYLINDER UNDER TORSION. S.B.Dutt.
Bull. Calcutta Math. Soc., Vol. 50, No. 1, 29-33 (March, 1958).

531.25

4969 TWISTING OF AN ELASTIC LAYER. Ya.S.Uflyand.
Dokl. Akad. Nauk SSSR, Vol. 129, No. 5, 997-9 (Dec. 11, 1959). In Russian.

Equilibrium values of the shearing strain of an infinite cylindrical shell twisted by an externally applied torque.
J.K.Skwirzynski

531.25

4970 THE DYNAMIC STRESSES PRODUCED IN ELASTIC BODIES BY UNEVEN HEATING. G.Eason and I.N.Sneddon.
Proc. Roy. Soc. Edinburgh A, Vol. 65, Pt 2, 143-76 (1959).

The presence of a non-uniform distribution of temperature in an elastic solid gives rise to an additional term in the generalized Hooke's Law connecting the stress and strain tensors and to a term involving the time rate of change of the dilation in the equation governing the conduction of heat in the solid. The present paper is concerned with the effects produced by these additional terms in two simple situations. In the first, the elastic solid is regarded as being of infinite extent and the distribution of temperature in the solid is produced by heat sources whose strength may vary with time. In the second, the solid is supposed to be semi-infinite and to be deformed by prescribed variations in the temperature of the bounding plane and by heat sources within itself.

531.25

4971 AN IMPROVEMENT IN THE PROCEDURE FOR PHOTOELASTIC MEASUREMENTS. J.Sapaly.
C.R. Acad. Sci. (Paris), Vol. 250, No. 2, 287-9 (Jan. 11, 1960). In French.

The improvement is directed at overcoming three defects which occur when photomultipliers are used in photoelasticity. These are fatigue of the photomultiplier, fluctuations in the h.t. supply and instability of the light source. The arrangement consists of a source, polarizer, quarter-wave plate, model, quarter-wave plate, analyser and photomultiplier arranged in this order. However, in contrast to the normal method of use the analyser is rotated at a constant speed and from the resultant photomultiplier output the path difference due to the model can be found. The method is briefly discussed together with its application to the study of deformation of metals using a photoelastic varnish. H.G.Jerrard

531.25

4972 EXPERIMENTAL METHOD OF INVESTIGATING STRESSES IN BUTTRESS DAMS. J.R.Rydzewski.
Brit. J. appl. Phys., Vol. 10, No. 10, 465-9 (Oct., 1959).

A photoelastic method is described for investigating the stress distribution in a buttress dam web of constant thickness, resting on an elastic foundation. The method is also applicable to the stress analysis of a gravity dam. The general case is considered when the elastic properties of the foundations differ from those of the material of the dam. The investigations were made by "frozen-stress" methods in which the composite model of the dam and foundations, together with its impounded liquid, was subjected to a centrifugal acceleration which amplified the body forces and liquid pressures about twenty-eight times. The model was analysed in a polariscope to obtain the difference of the principal stresses and their directions, while the sum of the principal stresses was found from measurements of the lateral extensions of the model. For the latter purpose a new technique was developed.

531.3

4973 ON THE MOTION OF A PARTICLE OF VARIABLE MASS UNDER THE ACTION OF A NEWTONIAN CENTRAL ATTRACTION. F.R.Marsicano.
Cienc. e Tec., Vol. 127, 170-82 (May, 1959). In Spanish.

Perturbation methods are employed in an investigation of the effect of mass variation on planetary orbits. Calculations are made for the case of a constant time rate of change of mass.

R.A.Newing

531.38

4974 NOTE ON PRECESSION. A.E.Benfield.
Amer. J. Phys., Vol. 26, No. 6, 396-7 (Sept., 1958).

The purpose of the note is to emphasize that precession is the rotary analogue of uniform circular motion. It is not claimed as an original observation, but is thought worthy of stress in the teaching and understanding of gyroscopic motion.

531.38

4975 ANOTHER NOTE ON PRECESSION. B.E.Pettersen.
Amer. J. Phys., Vol. 27, No.6, 429-30 (Sept., 1959).

Demonstrates that both precession and its analogue, uniform circular motion, involve the time rate of change of a vector whose magnitude is constant.

S.Weintroub

531.5 : 534.22

4976 MEASUREMENT OF THE EFFECTS OF PISTON MASS AND BURSTING PRESSURE ON THE MOTION OF A PISTON IN A HYPERSONIC GUN TUNNEL. B.J.Belcher.
Nature (London), Vol. 184, 1207-9 (Oct. 17, 1959).

Microwave reflections from the end of the piston are used to follow its motion; the barrel of the shock tube behaves as a resonant cavity. An oscillograph trace, with a raster-type display, is reproduced. The lay-out is shown, electrical circuits are described, and results are given graphically.

A.G.Gaydon

531.56

4977 ON THE APPLICATION OF THE STABILITY THEORY OF DIFFERENTIAL SYSTEMS TO THE STABILITY OF A MISSILE. I. L.Pottsepp and M.Z.v.Krzywoblocki.
Acta Phys. Austriaca, Vol. 13, No. 1, 48-64 (1960).

MECHANICAL MEASUREMENTS

531.71

4978 MEASUREMENT OF FIBRE DIAMETER VARIATION BY OPTICAL DIFFRACTION.
W.J.Onions and B.Ellingham.
Brit. J. appl. Phys., Vol. 10, No. 7, 328-32 (July, 1959).

A theory is developed relating the intensity of light refracted at any given angle by a parallel array of opaque fibres of unequal diameters with the mean diameter and the coefficient of variation of fibre diameter. The ratio of the intensities of the first minimum and the first maximum is shown to depend upon the coefficient of variation of fibre diameter. This affords an opportunity of measuring fibre diameter variation. The possibilities and limitations of the method in practice are explored.

531.71

4979 OPTICAL AND ELECTRICAL METHODS OF MEASURING THICKNESSES OF THIN METALLIC FILMS. Y.G.Naik and E.M.Balsara.
Indian J. Phys., Vol. 31, No. 12, 607-10 (Dec., 1957).

Measurement of thickness of chemically deposited thin films of silver are made from (i) the study of the absorption of light and (ii) from the electrical conductivity of these films. It is shown that the thicknesses determined by the two methods are of the same order.

531.71

4980 INVESTIGATIONS OF THE INFLUENCE OF TEMPERATURE VARIATIONS ON THE READINGS OF A COMPARATOR WITH LARGE MECHANICAL MAGNIFICATION.
R.Noch and H.Hühn.
Z. InstrumKde, Vol. 67, No. 11, 285-8 (Nov., 1959). In German.

Mechanical comparators with high magnification for linear measurements can alter their readings due to the influence of small changes of temperature. The paper deals with the influence of a slight heat source, for example an operator or a lamp, on comparators with a graduation of 0.0001 mm.

531.71 : 535.41

4981 A PARALLEL TESTING INTERFEROMETER FOR SLIP GAUGES UP TO FOUR METRES LONG.
M.Dühmke.
Z. InstrumKde., Vol. 67, No. 11, 273-6 (Nov., 1959). In German.

This apparatus does not need a highly monochromatic light-source; the accuracy is estimated to be ± 0.02 μ.

531.71 : 535.24

4982 RECORDING PROJECTION MICROMETER. N.A.Hunt, P.C.Russell, E.A.Stewardson and J.E.Wilson.
J. sci. Instrum., Vol. 36, No. 4, 164-5 (April, 1959).

This instrument was designed for making abscissa measurements on microdensitometer curves of X-ray multiplets. It is essentially a printing micrometer in which the curve is positioned by the use of an enlarging optical projection arrangement.

531.74

4983 USE OF RADIAL GRATINGS IN A SMALL INCLINOMETER. A.Lewis and I.R.Young.
J. sci. Instrum., Vol. 36, No. 4, 153-7 (April, 1959).

Some of the factors involved in the choice of gratings for use in the digital measurement of angles are discussed. This problem is accentuated in the case of the instrument described by its small size and the decision, therefore, to use two complete circles for the gratings, instead of the less critical method using one circle and adjustable grating-cursors. The tolerances which have to be achieved for satisfactory performance are considered and the instrument itself, a pendulous inclinometer intended to measure the pitch angle of wind tunnel models, is described.

531.75 : 545

4984 CONTINUOUS READING BALANCE FOR OXIDATION STUDIES. E.Dempsey.
J. sci. Instrum., Vol. 36, No. 2, 84-7 (Feb., 1959).

An instrument designed for studying the oxidation behaviour of a toxic radioactive metal is described. The mode of suspension, consisting of a crossed spring arrangement, while being very robust, permits the detection of mass changes of 50-100 μg in an initial specimen mass of 1-2 g.

531.76

4985 POSSIBLE USE OF NEWTON'S FIRST LAW IN DEFINING INTERVALS OF TIME. H.L.Armstrong.
Amer. J. Phys., Vol. 27, No. 2, 122 (Feb., 1959).

The author develops an argument supporting the proposal contained in the title.

E.G.Knowles

531.76 : 621.317.39

4986 DETERMINATION OF THE SPEED OF PASSING VEHICLES BY APPARATUS USING [INTERRUPTED] LIGHT BEAMS. F.G.Altman and K.H.Busch.
Z. InstrumKde, Vol. 67, No. 12, 311-18, (Dec., 1959). In German.

Deals with two different types of instrument. The speed is determined by the time taken for the vehicle to travel a known distance. One of the instruments indicates the time on a ballistic galvanometer and the other presents a digital display on an electronic counter.

MECHANICS OF FLUIDS

(See also Magnetohydrodynamics)

532.1

4987 STUDIES OF THE VISCOSITY AND SEDIMENTATION OF SUSPENSIONS. V. THE VISCOSITY OF SETTLING SUSPENSIONS OF SPHERICAL PARTICLES.
D.R.Oliver and S.G.Ward.
Brit. J. appl. Phys., Vol. 10, No. 7, 317-21 (July, 1959).

For Pt IV see Abstr.80 (1959). A description is given of a series

of viscosity measurements on upward- and downward-settling suspensions of spherical particles, in which an efflux type capillary-tube viscometer was employed. It is shown that the viscosity characteristics of settling suspensions are related to those of corresponding suspensions which do not settle, termed "stable suspensions". The degree of instability of the settling suspensions has a well-defined effect on the viscosity-concentration relationships. The measured values of the viscosity are shown to be modified by a form of wall effect, similar to that encountered during measurements on stable suspensions of spherical particles. The magnitude of the wall effect, however, changes with the degree of instability of the suspensions, and in one case varies also with the volume concentration of solids present. The final values of the relative viscosity, corrected for wall effect, are shown to be related to the volume concentration by a single type of equation, which is closely related to the one which applies to stable suspensions of spherical particles.

532.1

4988 THEORY OF NON-NEWTONIAN FLOW. III. A METHOD FOR ANALYZING NON-NEWTONIAN FLOW CURVES.
W.K.Kim, N.Hirai, T.Ree and H.Eyring.
J. appl. Phys., Vol. 31, No. 2, 358-61 (Feb., 1960).

For Pt I-II, see Abstr. 8329-30 (1955). The historical development of the rate theory of viscosity is briefly reviewed. The Ree–Eyring equation of generalized viscosity,

$$\eta = \sum_{n=1}^{m} (x_n\beta_n/\alpha_n)(\sinh^{-1}\beta_n\dot{s}/\beta_n\dot{s})$$

is applied successfully in a variety of (cases where $\dot{s}$ is the shear rate x is the fraction of the area on a shear surface occupied by the non-Newtonian flow units, $\alpha = \lambda\lambda_2\lambda_3/2kT$, $\beta = 1/\{(\lambda/\lambda_1)2k'\}$, k' is the rate constant for the flow process at zero stress, λ_1, λ_2, λ_3, and λ are the molecular distances). A new method is developed for determining the parameters x_n/α_n and β_n. According to the method, these parameters are uniquely determined. Using the parameters determined by the method, the viscosities for solutions of poly-γ-benzyl-l-glutamate were calculated. The equation is found to be superior to other frequently applied viscosity equations. Upon calculating the Newtonian viscosities η_s for fairly concentrated solutions of polyacrylonitrile and of nitrated pine pulp, the following empirical formula is found

$$\eta_s \cong KC^3M\beta_p^{1/2}$$

Here K is a characteristic constant for a solution; C the concentration; M the molecular weight; and β_p is the "principal" relaxation time. In dilute solutions, the equation reduces to the form $\eta_s \cong K'CM$.

532.5

4989 A NEW INFERENTIAL-TYPE FLOW METER WITH TWIN ROTORS. E.H.W.Allen.
Instrum. Engr, Vol. 2, No. 8, 149-52 (Oct., 1959).

532.5

4990 INSTRUMENT FOR MEASURING LIQUID FLOWS OF LESS THAN A MILLILITRE PER HOUR. J.R.Pilbrow.
J. sci. Instrum., Vol. 36, No. 6, 270-2 (June, 1959).

Flow is channelled through a narrow passage containing thermojunctions placed before and after a heated wire. The differential e.m.f. is proportional to the flow when this is small, up to 150 μV for 5 ml.h^{-1} in the existing instrument. Suitably large collectors buried in porous material can channel seepage into the instrument. Flows of 0.005 ml.cm^{-2}h^{-1} (to 20%) have been measured in this way in a river bed.

532.5

4991 SIMILARITY SOLUTIONS IN FLUID–GAS DYNAMICS. S.F.Borg.
Amer. J. Phys., Vol. 28, No. 4, 336-9 (April, 1960).

Following a brief discussion of the general applicability of similarity transformations in solving fluid–gas dynamic problems, certain specific problems solved in this manner are described.

532.5

4992 ON AXIALLY SYMMETRIC SUPERPOSABLE FLOWS. J.N.Kapur.
Bull. Calcutta Math. Soc., Vol. 51, No. 1, 25-33 (March, 1959).

Some cases are given in which the condition of superposability is satisfied. Four theorems are established relating to the superposability of two self-superposable flows. Non-steady solutions (in terms of Bessel's functions) are given for the vorticity decay.

532.5

4993 EXPERIMENTAL INVESTIGATION OF UNSTEADY FLOW OF VISCO-PLASTIC LIQUIDS. G.A.Rozenberg.
Dokl. Akad. Nauk SSSR, Vol. 129, No. 1, 56-8 (Nov. 1, 1959). In Russian.

Pressure pulses are generated by means of steel balls being dropped into a liquid. Measurements are made of the rate of damping of the pulses. Results are compared with theoretical deductions which depend on the assumption that the viscous dissipation in steady flow determines the damping of pulses. It is found that for water agreement between calculation and experiment is satisfactory. For three (unspecified) "visco-plastic" liquids agreement is poor. It is concluded that in these instances the damping is not fully determined by the dissipation in steady flow. R.Eisenschitz

532.5

4994 TRANSVERSE COMPONENT OF VELOCITY IN A PLANE SYMMETRICAL FORCED JET OF A COMPRESSIBLE FLUID. J.N.Kapur.
Bull. Calcutta Math. Soc., Vol. 51, No. 1, 34-8 (March, 1959).

532.5

4995 THE HYDRODYNAMIC STABILITY OF INVISCID FLOW BETWEEN COAXIAL CYLINDERS. S.Chandrasekhar.
Proc. Nat. Acad. Sci. U.S.A., Vol. 46, No. 1, 137-41 (Jan., 1960).

The conditions for stability are found, using an infinitesimal perturbation method. The analogue of Rayleigh's criterion is derived for cylindrical flow. A.H.Gabriel

532.5

4996 THE HYDRODYNAMIC STABILITY OF VISCID FLOW BETWEEN COAXIAL CYLINDERS. S.Chandrasekhar.
Proc. Nat. Acad. Sci. U.S.A., Vol. 46, No. 1, 141-3 (Jan., 1960).

Calculations similar to those described in the preceding abstract are made for the case of viscous flow. The effect of the Reynolds number for axial flow on the stability of the rotational flow is given in tabular form. A.H.Gabriel

532.5 : 537.36

4997 ELECTROKINETIC EFFECTS AND ELECTRONIC VISCOSITY IN LIQUID METALS. II.
V.B.Fiks and G.E.Pikus.
Fiz. tverdogo Tela, Vol. 1, No. 7, 1147-58 (July, 1959). In Russian.

Liquid metal flowing through a thin capillary differs from metal at rest by its electronic distribution function. The function is derived by solving the appropriate collision equation. The distortion of the equilibrium distribution gives rise to a current. The distribution of current density over the cross-section of the capillary is obtained quantitatively in terms of the electronic mean free path. Owing to the presence of this current, the force necessary for driving the liquid through the capillary is modified; this effect is specified in terms of an "electronic viscosity". R.Eisenschitz

532.5

4998 THE FLOW OF BLOOD THROUGH NARROW TUBES. M.Reiner and G.W.Scott Blair.
Nature (London), Vol. 184, 354 (Aug. 1, 1959).

Casson [The Rheology of Disperse Systems. Edited by C.C.Mill. London: Pergamon Press (1959), Chapter 5], has proposed an equation for the flow of varnishes and inks in capillary tubes

$$\left(\frac{rP}{2L}\right)^{1/2} = k_0 + k_1\left(\frac{4V}{\pi r^3}\right)^{1/2}$$

P = pressure, V = volume flow/sec, r = radius, L = length of tube, k_0 and k_1 are constants. For finite values of k_0 the equation gives a value for critical shearing stress which is first reached at the walls and with further increase in pressure at a critical distance r_0 from the centre. r_0 decreases with increasing pressure. Correction of the above equation to allow for changing r_0 is made and the relation obtained

$$\left(\frac{4V}{\pi r^3}\right)^{1/2} = \frac{1}{k_1}\left[\tau_r^{1/2} - 8k_0/7\right]$$

where τ_r is the shear stress at the wall. k_1^{-1} and $8k_0/7$ are then obtained as intercepts on the axes of the line $(4V/\pi r^3)^{1/2}$ plotted against $\tau_r^{1/2}$. T.C.Toye

532.5

4999 ON THE STATISTICAL THEORY OF TURBULENCE. S.Pantchev.
C.R. Acad. Sci. (Paris), Vol. 250, No. 4, 661-2 (Jan. 25, 1960). In French.

A preliminary note. A partial differential equation is obtained for the correlation function relating two temperatures at different times and positions in spatially homogeneous and stationary turbulence. The equation is similar to one already obtained by Chandrasekhar for the similar function correlating velocities.

H.N.V.Temperley

532.5

5000 A SPECTRUM OF TURBULENCE AT VERY HIGH REYNOLDS NUMBER.
H.L.Grant, A.Moilliet and R.W.Stewart.
Nature (London), Vol. 184, 808-10 (Sept. 12, 1959).

The downstream component of turbulent velocity was recorded by a hot-film anemometer in a sea-water channel with tidal current 100 cm/sec and Reynolds number 4×10^5 (based on depth). The energy and dissipation spectra are plotted, and are reliable at least in the range of wave numbers 0.02 to 1 cm^{-1}. The ratio of the wave number for maximum dissipation to the characteristic wave number of the dissipation range (a universal constant on Kolmogoroff's theory) is calculated as 5.4. J.G.Oldroyd

532.5

5001 SIMILARITY STRUCTURE OF VORTICITY FLUCTUATION AND THE THEORY OF TURBULENCE.
Chou Pei-Yuan.
Scientia Sinica, Vol. 8, No. 10, 1095-119 (Oct., 1959).

Equations for velocity variations from the mean motion, referred to a coordinate system moving with the mean turbulent flow, are discussed in relation to dynamical similarity. Local fluctuations are characterized by a turbulent vorticity scale number. Turbulent flows in a channel, along a flat plate, in a pipe and in a wake are used to illustrate an approximate theory, and there is agreement with experiment. J.G.Oldroyd

532.6

5002 THE EPITASIMETER: AN INSTRUMENT FOR PROCESS CONTROL BY MEANS OF THE CONTINUOUS MEASUREMENT OF SURFACE TENSION. W.H.Aarts.
J. sci. Instrum., Vol. 36, No. 6, 252-5 (June, 1959).

Physical methods of determining chemical concentrations are very useful in the control of process plants. While many physical properties have been so used, little use seems to have been made of surface tension. Surface tension measurements are frequently used in the laboratory, and generally an absolute value of the surface tension is required. For process control, however, absolute measurements are often not essential. The method described here uses a jet of liquid issuing from an elliptical orifice to form a standing wave. Viscosity effects are either eliminated or allowed for in the temperature compensating circuits.

532.6

5003 APPARATUS FOR MEASURING THE SPREADING COEFFICIENT OF A LIQUID ON A SOLID SURFACE.
J.F.Padday.
J. sci. Instrum., Vol. 36, No. 6, 256-7 (June, 1959).

The apparatus described provides a direct-reading instrument for the measurement of the spreading coefficient of a liquid on a solid surface. The determination is based on the measurement of the maximum height of a sessile drop of the liquid-solid system.

532.6

5004 CALCULATION OF SURFACE TENSIONS OF LIQUIDS FROM LIQUID DENSITY AND VAPOR PRESSURE.
I.Reich.
J. Colloid Sci., Vol. 14, No. 5, 562-4 (Oct., 1959).

A simple calculation is made of the free surface energy of a liquid, as a function of density, vapour pressure and molecular weight, by treating the region of surface molecules as resembling a compressed perfect gas (rather than a liquid) to the extent that these molecules have lost about one-quarter of their near neighbours. There is agreement with experiment in many liquids that are not highly associated, at temperatures at which the vapour pressure is well below an atmosphere. J.G.Oldroyd

532.6

5005 DEPENDENCE OF SURFACE TENSION UPON THE RATES OF FORMATION AND AGEING OF THE SURFACE. W.Göring.
Z. Elektrochem., Vol. 63, No. 9-10, 1069-77 (1959). In German.

A vertical jet of water is directed against the centre of a horizontal circular plate so that the flowing liquid forms a film of near-spherical shape. The accurate shape of the film is investigated by photographic recording. A theoretical deduction of the shape is made by using hydrodynamic equations whereby viscosity is neglected but surface tension is taken into account. The result is used for deriving values of the surface tension from the experimental shape of the films. It is found that the surface tension varies over the length of the streamlines. This interpretation is maintained after a discussion of possible sources of error. The surface tension of water is thus found to have "dynamical" values of 150-100 c.g.s. units which gradually approach towards the "static" value of 72. The rate of approach corresponds to a relaxation time of approximately 10^{-3} sec. R.Eisenschitz

532.6 : 537.2

5006 METHOD OF VIRTUAL WORK FOR SOME PROBLEMS IN PHYSICS. S.N.Srivastava.
Amer. J. Phys., Vol. 28, No. 4, 299-301 (April, 1960).

The method of virtual work is applied to solve a number of problems in surface tension, and one problem in electrostatics. It is found that the solution is much simplified in many cases. The treatment is uniform in every case and is easily understandable.

LIQUID STATE

(Liquid helium is included under Low-Temperature Physics)

532.7

5007 A SIMPLE MOLECULAR-STATISTICAL THEORY OF THE NEMATIC LIQUID CRYSTALLINE PHASE. I.
W.Maier and A.Saupe.
Z. Naturforsch., Vol. 14a, No. 10, 882-9 (Oct., 1959). In German.

An expression for the mean intrinsic field of a nematic molecular arrangement, acting on a single molecule, is derived assuming that the dipole-dipole part of the pure dispersion interactions is probably a determining factor for the existence of a liquid crystalline phase. It is shown that such an intrinsic field must cause (in a certain range of temperature) a nematic ordering which must become discontinuous at a certain temperature and pass into the isotropic arrangement. The transformation point of the 1st order, observed in experiments, is foreseen by this theory. F.Lachman

532.7

5008 THE SELF-DIFFUSION IN LIQUID ZINC. W.Lange, W.Pippel and F.Bendel.
Z. phys. Chem. (Leipzig), Vol. 212, No. 3-4, 238-40 (1959). In German.

The coefficient of self-diffusion was determined at a number of temperatures from the m.p. up to 600°C. An exponential temperature relation fits the results and the activation energy for self-diffusion is found to be 5600 cal/mol. The immersed capillary method employing Zn^{65} was used. T.C.Toye

532.7

5009 ON THE CALCULATION OF RELAXATION TIMES. C.R.K.Murty.
Indian J. Phys., Vol. 32, No. 12, 580-1 (Dec., 1958).

Relaxation times were calculated for polar molecules in dilute solution of non-polar solvents.

532.7

5010 COMPRESSIONAL RELAXATION WITH A TUNING FORK. J.H.Andreae, C.Jupp and D.G.Vincent.
J. Acoust. Soc. Amer., Vol. 32, No. 3, 406-7 (March, 1960).

A new resonator comprising a fused quartz tuning fork with a hollow, liquid-filled arch has been used to measure compressional loss in the liquid. Initial measurements on an aqueous solution of $BeSO_4$ near 100 c/s confirm the existence of relaxational behaviour in this solution.

532.7

5011 FINE STRUCTURE OF THE RAYLEIGH LINE AND THE DISPERSION OF HYPERSOUND IN VISCOUS LIQUIDS.
M.S.Pesin and I.L.Fabelinskii.
Dokl. Akad. Nauk SSSR, Vol. 129, No. 2, 299-302 (Nov. 11, 1959). In Russian.

The velocity of hypersound in glycerine in the range −50° to 150° C is given and compared with measurements at ultrasonic frequencies. J.Jarzynski

532.7

5012 DEPENDENCE OF ACOUSTIC VELOCITY IN SOME AQUEOUS HYDROXIDE SOLUTIONS ON TEMPERATURE AND CONCENTRATION. G.W.Marks.
J. Acoust. Soc. Amer., Vol. 32, No. 3, 327-35 (March, 1960).

The present work, which deals with acoustic velocity at 500 kc/s in aqueous solutions of LiOH, NaOH, KOH, and NH_4OH and results derived therefrom, follows that which was recently reported concerning solutions of certain sulphates. It was found that the velocity vs temperature curves rise and are displaced toward lower temperatures with increase in concentration. The specific acoustic impedance varies linearly with concentration at 20° C. Adiabatic compressibilities are represented by the empirical 3/2-power law. Results for NH_4OH are at variance with those for the other hydroxides. The relative association declines with increase in concentration in solutions of NH_4OH whereas it increases for the other hydroxides. From the data the apparent molal compressibilities were computed for the temperature range 15° to 35° C. Based on values of the apparent molal compressibilities at infinite dilution the solvation appears to be about six water molecules per ion.

532.7 : 534.22

5013 THE CALCULATION OF SOUND VELOCITY IN ELECTROLYTIC SOLUTIONS. T.Yasunaga.
J. Sci. Hiroshima Univ. A, Vol. 22, No. 3, 301-6 (Dec., 1958).

Rao's relationship between the thermal coefficient of sound velocity and the thermal coefficient of density (Abstr. 3183 of 1940) has been extended to the calculation of sound velocity in aqueous electrolytic solutions. The calculated values are in good agreement with the observed values. In this calculation, it has been assumed that the solution consisted of the incompressible ion and the water, where the water had undergone the various hydration pressures. Also, Rao's relationship has been tested for pressure variation up to a value of 6000 kg/cm² in water.

532.7

5014 THEORY OF THE HEAT OF TRANSPORT OF ELECTROLYTIC SOLUTIONS.
E.Helfand and J.G.Kirkwood.
J. chem. Phys., Vol. 32, No. 3, 857-66 (March, 1960).

The limiting concentration dependence of the heat of transport of an ionic component of a dilute solution of electrolyte is determined. The theory is based on recasting the Bearman–Kirkwood statistical mechanical expression for the heat current into a form linear in the particle diffusion currents and identifying the coefficients with the heat of transport. Ion–ion interactions are treated exactly to the order $c^{1/2}$ by using a nonequilibrium correlation function determined from the Debye–Hückel radial distribution function by Brownian particle theory. A hydrodynamical model is employed for the analysis of the effect of ion–solvent interaction. Indications are that the latter contributions are often, but not always, negligible. There is accord between the theory and experimental data.

532.7 : 536.42

5015 RELATIONSHIP BETWEEN HEAT CONDUCTIVITY, MOLECULAR WEIGHT, AND FREEZING POINT OF LIQUIDS. S.Visvanathan and I.Sanghi.
Naturwissenschaften, Vol. 46, No. 23, 647 (1959).

Mohanty [Curr. Sci., Vol. 17, 148(1948)] showed empirically that the product of the heat conductivity of a liquid at its boiling point and $M^{1/3}$ (where M is the molecular weight) is a constant for some aliphatic liquids. The relationship is extended to the freezing point T_m and to aromatic liquids. It is shown that if $K\sqrt{M}$ is constant, (where K is the heat conductivity of the liquid) then $T_m^{1/3}/V^{2/3}$ is also a constant. (V is the molecular volume.) Values for eight liquids are tabulated in verification. S.Weintroub

532.7

5016 THERMODYNAMIC PROPERTIES OF SULFURYL FLUORIDE FROM 12° K TO ITS BOILING POINT. ENTROPY FROM MOLECULAR AND SPECTROSCOPIC DATA.
F.J.Bockhoff, R.V.Petrella and E.L.Pace.
J. chem. Phys., Vol. 32, No. 3, 799-804 (March, 1960).

The heat capacity of sulphuryl fluoride was measured from 12 to 218° K. A lambda transition was observed at 65.7° K. The heat of fusion at the triple-point temperature, 137.34° K, was 1074 cal/mole. The heat of vaporization at the normal boiling point, 217.78° K, was 4596 cal/mole. The vapour pressure data are closely represented by the equation

$$\log_{10}P_{mm} = 7.8323 - 1071.235/T - 0.02391 \log_{10}T.$$

The liquid density from 182 to 204° K is closely represented by the equation

$$d = 2.576 - 0.004044T.$$

The entropy of sulphuryl fluoride gas was calculated from the calorimetric data and the third law of thermodynamics to be 62.66 e.u./mole at 217.78° K. The calculated spectroscopic entropy was 63.24 e.u./mole. The discrepancy, 0.58 e.u./mole is attributed to randomness in the solid at 0° K.

532.7

5017 THERMODYNAMIC PROPERTIES OF TRIFLUOROMETHANETHIOL FROM 12° K TO ITS BOILING POINT. ENTROPY FROM MOLECULAR AND SPECTROSCOPIC DATA.
R.E.Dininny and E.L.Pace.
J. chem. Phys., Vol. 32, No. 3, 805-9 (March, 1960).

The heat capacity of trifluoromethanethiol was measured from 12° to 227° K. The heat of fusion at the triple point temperature, 116.04° K, was 1177 cal $mole^{-1}$. The heat of vaporization at the normal boiling point, 235.16° K, was 4798 cal $mole^{-1}$. The vapour pressure was measured, and the data are represented by the equation $\log_{10}p_{mm} = (-1352.568/T) - 2.686918 \log_{10}T + 15.00409$. The entropy of the trifluoromethanethiol gas calculated from the calorimetric data was 69.45 ± 0.17 e.u. at 235.16° K. The result calculated from spectroscopic data and structural parameters for the molecule was 70.19 e.u. The discrepancy of 0.74 ± 0.17 e.u. is attributed to a potential barrier of 1540 ± 260 cal $mole^{-1}$ restricting the internal rotation of the trifluoromethyl group.

532.7

5018 MICROWAVE DIELECTRIC MEASUREMENTS IN A LIQUID CRYSTAL THAT SHOWS POLYMESOMORPHISM.
E.F.Carr.
J. chem. Phys., Vol. 32, No. 2, 620-1 (Feb., 1960).

Dielectric loss measurements at 1.2 cm in the temperature range 80° to 200° C on ethyl anisol p-aminocinnamate. A study was made of the effect of a magnetic field of 4500 G parallel or perperdicular to the polarized microwaves for a variety of mechanical and thermal treatments of the material. J.G.Powles

532.7

5019 EXPERIMENTAL AND THEORETICAL ASPECTS OF HIGASI'S EQUATION FOR A QUICK DETERMINATION OF ELECTRIC DIPOLE MOMENT IN SOLUTION.
B.Krishna and K.K.Srivastava.
J. chem. Phys., Vol. 32, No. 3, 663-4 (March, 1960).

The electric dipole values for twenty-three organic solutions were determined by Higasi's method. Except for two substances, namely iodoform and ethylene dibromide, the dipole values so obtained agree fairly well with those obtained by usual methods. A reassessment of Higasi's equation has been made on theoretical grounds and a more general equation obtained.

532.7

5020 DIELECTRIC RELAXATION OF DILUTE SOLUTIONS IN THE MILLIMETER WAVE REGION. J.Schneider.
J. chem. Phys., Vol. 32, No. 3, 665-8 (March, 1960).

The dielectric losses of benzophenone, diphenylether, diphenylamine, chlorobenzene, and aniline, measured at 12.33, 6.19, 3.08 and 2.47 mm wavelength in dilute benzene solutions, were found to fit Debye type relaxation curves within the limits of experimental error. The distinctly lower relaxation time of diphenylether and of diphenylamine, compared to the one for benzophenone, can be explained by a high internal mobility of the phenyl rings in these two molecules. Similarly, the mobility of the amino group in aniline results in a decrease of the relaxation time, compared to the rigid chlorobenzene molecule.

532.7 : 537.2

5021 DIELECTRIC INVESTIGATIONS OF THE RELAXATION BEHAVIOUR OF CONCENTRATED SOLUTIONS IN THE MICROWAVE REGION.

W.Zeil, H.Fischer, W.Metzger, K.Wagner and J.Haase.
Z. Elektrochem., Vol. 63, No. 9-10, 1110-20 (1959). In German.

Reports measurements of dielectric constant and loss in the frequency range 1000 to 10 000 Mc/s and at 20, 40 and 60°C for solutions of a number of polar aromatic molecules in benzene, n-heptane, carbon tetrachloride and decalin. Reaction rate theory is used to analyse the dielectric relaxation times. It is thought that there is a relation between activation energy and intermolecular forces and also one between activation entropy and free volume and molecular dipole moment. J.G.Powles

532.7 : 537.2

5022 DIELECTRIC RELAXATION — EFFECT OF TEMPERATURE. K.V.Gopala Krishna.
Indian J. Phys., Vol. 32, No. 8, 387-96 (Aug., 1958).

Dielectric relaxation times were determined over a wide range of temperatures for benzophenone, ethyl benzoate, α-nitronaphthalene and ethyl adipate dissolved in heptane and ethyl adipate dissolved in heptane and ethyl adipate in decalin. The results have been discussed in the light of Eyring's theory (1941) on dipole rotation.

532.7 : 537.2

5023 POSSIBILITY OF LIQUIDS WITH HIGH DIELECTRIC CONSTANT AND LOW CONDUCTIVITY. N.Félici.
C.R. Acad. Sci. (Paris), Vol. 249, No. 14, 1196-8 (Oct. 5, 1959). In French.

Polar liquids are much less ionized than solid semiconductors, though their dissociation energy is comparable. This is explained by the reduction of entropy due to the molecular orientation in the electric field of the ions, and the conductivity of pure polar liquids should be very low. J.B.Birks

532.7 : 537.2

5024 SEMI-MACROSCOPIC TREATMENT OF THE THEORY OF NON-LINEAR PHENOMENA IN DIELECTRIC LIQUIDS SUBMITTED TO STRONG ELECTRIC AND MAGNETIC FIELDS. S.Kielich.
Acta phys. Polon., Vol. 17, No. 4, 239-55 (1958).

The deviation from the quadratic effect of dielectric saturation in a strong electric field is calculated for polar liquids with molecules exhibiting isotropic polarizability. General expressions are derived describing the effect of a strong electric or magnetic field on the index of refraction and on the dielectric permittivity. The Kerr and Cotton–Mouton constants, as well as the variation of the dielectric permittivity in electric and magnetic fields are also found. The molecular interpretation of the results yields formulae derived by the molecular method.

532.7 : 537.2

5025 SUPPLEMENT TO THE MEASUREMENT OF COMPLEX DIELECTRIC CONSTANT OF LIQUID IN THE MICROWAVE REGION BY THE FOUR-BRANCHED COAXIAL LINE. H.Yamamura and K.Hiraga.
J. Sci. Hiroshima Univ. A, Vol. 22, No. 3, 307-13 (Dec., 1958).

For the dielectric studies of the structures of various solutions, Yamamura proposed the four-branched coaxial line as a method for measuring the complex dielectric constant ϵ^* of liquid, and reported that this method was especially suitable for liquids with high dielectric loss (Abstr. 8255 of 1954). However, since it was sometimes observed that the measured values had considerable deviations, the authors decided to discover the reason why such deviations could occur. Finally, the accuracy of the method is investigated in detail.

532.7 : 537.2

5026 DIELECTRIC ABSORPTION MEASUREMENTS ON DILUTE SOLUTIONS AT MILLIMETRE WAVELENGTHS. H.Kramer.
Z. Phys., Vol. 157, No. 1, 134-8 (1959). In German.

A K-band klystron with frequency multiplication is used to supply power at 7 mm wavelength to a waveguide filled with the sample liquid. The variation of transmitted energy with varying specimen length is used to calculate ϵ''. Results are shown for solutions of chlorobenzene and of benzophenone in three non-polar solvents. K.W.Plessner

532.7 : 535.33

5027 ABSORPTION OF MICROWAVES IN SOLUTIONS OF ORTHO-CHLOROPHENOL. T.J.Bhattacharyya.
Indian J. Phys., Vol. 32, No. 12, 573-7 (Dec., 1958).

The absorption of 3.18 cm microwaves in solutions of o-chlorophenol in CCl_4 has been studied using an optical method. It was found that the 15% solution shows a maximum at – 13°C. The aggregate absorption is found to increase with lowering of concentration. These results have been discussed in the light of the investigations on the i.r. and Raman spectra of solutions of the compound in different solvents reported by previous workers. It is concluded that in dilute solution of CCl_4, the OH group in most of the molecules possesses freedom of rotation.

532.7 : 539.19

X-RAY DIFFRACTION STUDY OF BISMUTH POLYMER IN AQUEOUS PERCHLORATE SOLUTION. See Abstr. 4247

532.7 : 535.3

5028 INFRARED DISPERSION MEASUREMENTS AND INTEGRATED ABSORPTION COEFFICIENTS FOR PURE LIQUID BENZENE. P.N.Schatz.
J. chem. Phys., Vol. 32, No. 3, 894-9 (March, 1960).

The refractive index of pure liquid benzene was measured in the 2 to 21μ region to an accuracy of about ±0.003 using an interferometric technique developed by Kagarise and Mayfield. A general relation is derived between the refractive index and integrated absorption coefficients of a pure liquid. The relation is used to determine the absolute intensities of the fundamental vibrations of pure liquid benzene from the dispersion data. A comparison is made with the same intensities determined in the direct absorption measurements of Hisatsune and Jayadevappa. The dispersion values appear to be higher than the absorption results, the difference being about 40% for the 14.8μ fundamental where the most accurate comparison is possible. A comparison between pure liquid and gas intensities is also made. A brief discussion is given of the advantages and limitations of the dispersion method in determining integrated intensities in liquids.

532.7 : 535.37

5029 NOTE ON PAPER BY M.TRLIFAJ. L.Trlifaj.
Czech. J. Phys., Vol. 9, No. 6, 747 (1959).

A simple derivation for mean lifetime of fluorescence in solution is given which yields similar results to those obtained in a more complex way in a previous paper (see Abstr. 4028 of 1959). G.F.J.Garlick

532.7 : 535.37 : 536.48

5030 SCINTILLATIONS FROM LIQUID HELIUM. H.Fleishman, H.Einbinder and C.S.Wu.
Rev. sci. Instrum., Vol. 30, No. 12, 1130-1 (Dec., 1959).

The scintillation of liquid helium due to alpha-particles from U^{233} were observed and compared with other known scintillations. Under optimum conditions the signal is well above background, its energy resolution is good and there is little self-absorption of the light output in the liquid helium. To observe the light pulses quaterphenyl was used as a wavelength shifter. The scintillations from the liquid helium were compared with other known scintillations using a CsI crystal. The pulse-height ratio between liquid helium and CsI is about 1 : 2. The pulse-height resolution of U^{233} alpha-particles in liquid helium is about 20% while that of CsI is 13%. Since there was a loss of light by transmission through a Lucite assembly the initial energy resolution in liquid helium is better than that indicated. The scintillations could only be detected with the aid of the wavelength shifter and no measurement could be made for the rise time of the pulse. Scintillations were also observed from the saturated vapour of liquid helium. C.F.Barnaby

532.7 : 535.37

5031 REMARKS ON THE THEORY OF CONCENTRATION DEPOLARIZATION OF FLUORESCING SOLUTIONS. C.Bojarski.
Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 5-6, 249-51 (1960). In German.

Describes a method of calculating certain constants appearing in the theories of Vavilov and Förster. S.T.Henderson

532.7 : 535.37 : 539.2

ON THE DETERMINATION OF CRITICAL MOLECULAR SPACING FOR CONCENTRATION-DEPOLARIZATION OF FLUORESCENCE. See Abstr. 4423

532.7 : 535.37 : 539.1.07

5032 NEW LIQUID SCINTILLANT. H.A.Miranda, Jr and H.Schimmel.
Rev. sci. Instrum., Vol. 30, No. 12, 1128-9 (Dec., 1959).

The use of Dow Corning Silicone-555, a base for cosmetics, as

a primary liquid scintillant is described. It sustains rather large quantities of certain hydrocarbons in solution, among which are many of the commonly used fluors. It is water clear, has a refractive index of 1.49, and prolonged contact with Lucite shows no effect. The viscosity is about 20 centipoises. The disadvantage is that it is somewhat costly. The pulse-height, relative to anthracene, was found to be about 41%. This result was obtained using the Compton peak from Cs^{137}, and a concentration of 100 g/l naphthalene + 4 g/l PPO. The preparation of the mixture is very simple and procedures usually called for to prevent contamination can largely be dispensed with. It is claimed that the decay constant of the scintillant is less than 20×10^{-9} sec. C.F.Barnaby

532.7 : 535.37 : 539.2

THE DELAYED LIGHT EMISSION OF SCINTILLATOR MATERIALS IN THE MICROSECOND REGION. See Abstr. 4429

532.7 : 538.27

5033 NUCLEAR SPIN RELAXATION IN LOW-TEMPERATURE LIQUIDS. I.Oppenheim and M. Bloom.

Canad. J. Phys., Vol. 37, No. 11, 1324-7 (Nov., 1959).

A theoretical expression for the correlation function of interactions responsible for nuclear spin lattice relaxation is given without proof, and is used to obtain expressions for the relaxation times in atomic and molecular liquids in terms of their diffusion coefficients. The theory remains applicable at low temperatures where only the lowest rotational states of molecules are excited. E.F.W.Seymour

532.7 : 538.27

5034 RELAXATION IN A SYSTEM HAVING A LONG CORRELATION TIME. J.M.Winter.

C.R. Acad. Sci. (Paris), Vol. 249, No. 15, 1346-7 (Oct. 12, 1959). In French.

An attempt has been made to verify quantitatively the Bloch equations for relaxation times T_1 and T_2, by making measurements on spin systems which allow independent calculation of the parameters affecting T_1 and T_2. S.A.Ahern

532.7 : 538.27

5035 MAGNETIC RELAXATION IN LIQUIDS IN THE PRESENCE OF A HIGH FREQUENCY FIELD. I.Solomon.

C.R. Acad. Sci. (Paris), Vol. 249, No. 17, 1631-2 (Oct. 28, 1959). In French.

Reports measurements of proton relaxation times T_1, T_2 long (in the direction of H_0), and T_2 trans (perpendicular to H_0), for various values of H_0 for formamide at 2000 G. According to theory derived by Winter (see preceding abstract), when a scalar interaction is dominant one has T_2 long. = T_2 trans. = $T_2(H_0)$, and $T_2(H_0)$ rises with increasing H_0 towards T_1. This effect has been observed in formamide where $T_2(0) = 35$ msec and $T_1 = 2.06$ sec and is in good agreement with the theory. J.G.Powles

532.7 : 538.27

5036 ON NUCLEAR MAGNETIC RESONANCE IN FLOWING LIQUID. A.Z.Hrynkiewicz and T.Waluga.

Acta phys. Polon., Vol. 16, No. 5, 381-8 (1957).

The dependence of the amplitude of the absorption lines on the rate of flow was investigated. It was established that the flowing liquid method allows a simultaneous determination of the saturation factor and the longitudinal relaxation time; the relaxation time measurement may be made for any (not too small) degree of saturation. It was also shown that the limit of applicability of the method can, in comparison with the limit of applicability given by Suryan (Abstr. 5557 of 1951), be shifted considerably in the direction of long relaxation times.

532.7 : 538.27 : 539.2

NUCLEAR RESONANCE IN LIQUID METALS: A COMPARISON OF ELECTRONIC STRUCTURES. See Abstr. 4530

532.7 : 538.27

5037 AN EXPERIMENT ON NONADIABATIC PASSAGE IN NUCLEAR MAGNETIC RESONANCE.

A.Z.Hrynkiewicz, T.Waluga and G.Zapalski.

Acta phys. Polon., Vol. 17, No. 1, 71-5 (1958).

The method of nuclear resonance in a flowing liquid has been used to demonstrate the non-adiabatic passage. Magnetic fields of various amplitudes and orientations were suddenly superimposed upon the magnetic field determining the initial direction of magnetization. The results obtained are a simple confirmation of the vector model of non-adiabatic passage and constitute a good illustration of this process.

532.7 : 538.27

5038 NUCLEAR MAGNETIC RESONANCE IN BISMUTH. C.P.Flynn and E.F.W.Seymour.

Proc. Phys. Soc., Vol. 73, Pt 6, 945-7 (June, 1959).

The conduction electron shift of the resonance in liquid and in supercooled bismuth, measured with respect to that in bismuth nitrate solution, amounted to 1.41%. No resonance was observed in solid bismuth. E.F.W.Seymour

532.7 : 538.27 : 539.19

5039 PROTON MAGNETIC RESONANCE IN LIQUID ISO-BUTYL BROMIDE. K.Luszczynski and J.G.Powles.

Proc. Phys. Soc., Vol. 74, Pt 4, 408-16 (Oct. 1, 1959).

Proton magnetic resonance relaxation times T_1 and T_2 in liquid iso-butyl bromide [$(CH_3)_2CHCH_2Br$] have been measured at 21.5×10^6 c/s over the temperature range 110°K to 330°K. The results, together with others for T_2 down to 90°K, are interpreted in terms of molecular motion of the molecule as a whole and of the methyl groups in it. This extremely wide temperature range without phase transitions allows a severe test of the validity of theories of nuclear relaxation in molecular substances. The correlation frequency as a function of temperature which ranges from 10^3 c/s to 10^{11} c/s is deduced and a remarkably good correlation with dielectric loss measurements is found. A distribution of correlation frequencies of molecular reorientation at low temperatures is confirmed and the effect of the more rapid reorientation of one methyl group is found. This is a case in which the nuclear resonance parameters are controlled principally by the motion of the molecule as a whole but are modified by an internal molecular motion which is considerably faster.

532.7 : 538.27

5040 MULTIPLE QUANTA TRANSITIONS OF PROTONS. S.Wilking.

Z. Phys., Vol. 157, No. 3, 401-6 (1959). In German.

Multiple (n) quanta absorption by protons in water in weak (<10 gauss) magnetic fields have been observed up to n = 6 using a technique described in Abstr. 5433 (1960). The transition probabilities have been measured as a function of n and of field, and agree with the theory (Winter, Abstr.567, 8940 of 1956). J.G.Powles

MECHANICS OF GASES

533.2

5041 ELECTROLYTIC HYGROMETERS FOR MEASUREMENTS IN GASES DOWN TO A FEW PARTS PER MILLION. J.K.Crawshaw and F.G.Davidson.

J. sci. Instrum., Vol. 36, No. 3, 121-5 (March, 1959).

Another method for making electrolytic hygrometers is described, together with detailed measurements of their characteristics. The hygrometer is well fitted for continuously recording the water content of suitable gases in ranges down to a few parts per million. An instrument is described for making rapid specification tests on cylinders of the refrigerant dichlorodifluoromethane.

533.4

5042 METHOD OF DETERMINING THE DYNAMIC CONSTANTS OF LIQUID-CONTAINING MEMBRANE MANOMETER SYSTEMS. R.J.Linden.

J. sci. Instrum., Vol. 36, No. 3, 137-40 (March, 1959).

An instrument with which to produce sine and square wave changes in pressure in the hydraulic systems of membrane manometers is described. It consists of a cylindrical chamber to one end of which a metal membrane is secured; fixed to the membrane is a barium titanate strain gauge which, when energized by alternating voltages, causes alternating pressure changes in the chamber. The theory on which the construction of this instrument is based is substantiated by experiment. The use of the instrument in the examination of a damped capacitance manometer system is described.

533.4

5043 LIQUID MANOMETER WITH ELECTROMAGNETIC BALANCE INDICATOR. J.F.Kemp.

J. sci. Instrum., Vol. 36, No. 2, 77-81 (Feb., 1959).

Describes the construction and operation of a null-reading type of liquid manometer, which utilizes an electromagnetic device for balance indication, and a set of analytical weights for indirect "weighing" of the unknown differential pressure. The apparatus was designed specially for measurements in the range of differential pressurs below 5 mm water gauge. The probable error under laboratory conditions was found to vary from less than 0.01 mm water gauge at maximum range, to about 0.0005 mm water gauge at a differential pressure of 0.01 mm water gauge. Apart from its normal applications as a manometer, the apparatus can be used as an indicator of the flow dynamic head in low-speed wind-tunnels.

533.6

5044 THERMO-GAS DYNAMICS OF FLOW IN A CYLINDRICAL TUBE. O.Lutz.

Ingen.-Arch., Vol. 28, 178-83 (1959). In German.

The relationship

$$2\,\Delta T/(T_{g,w}-T_w) = \Delta p/\tfrac{1}{2}\rho w^2,$$

where ΔT and Δp are the temperature and pressure drops in the tube direction, $T_{g,w}$ the gas temperature at the wall of the tube, T_w the wall temperature and $\frac{1}{2}\rho w^2$ the dynamic pressure in the flow, is assumed to apply in both the subsonic and supersonic regions. It is shown that the mathematical treatment of the problem of flow can then be reduced to an Abel-type differential equation, containing two variables, a temperature function and a velocity function, which can be solved numerically. Using a graphical representation of the functions a general discussion of the phenomena of the flow is given. It is shown that in the cooling region "thermal choking" (Verblocken) can occur. S.Weintroub

533.6

5045 HYPERSONIC FLOW NEAR THE LEADING EDGE OF A FLAT PLATE. H.T.Nagamatsu and T.Y.Li.

Phys. of Fluids, Vol. 3, No. 1, 140-1 (Jan.-Feb., 1960).

A first-order theory, based on the kinetic theory of gases, explains the evidence of the slip region at the leading edge. H.D.Parbrook

533.6

5046 STUDY OF GAS-LUBRICATED, HYDRODYNAMIC, FULL JOURNAL BEARINGS. S.Whitley and C.Betts.

Brit. J. appl. Phys., Vol. 10, No. 10, 455-63 (Oct., 1959).

The two characteristics under investigation were load-carrying capacity and half-speed whirl. The gases used as lubricants were mainly hydrogen, nitrogen and neon, giving a large viscosity variation; argon and carbon dioxide were also used to investigate the effect of the ratio of specific heats (γ). The bearings used were plain cylinders with a longitudinal groove cut into the upper surface of each bearing, extending over half the bearing length. It had been shown previously that this groove improved the half-speed whirl characteristics, and tests on bearings without the groove, also included, demonstrate that the groove does not affect the load capacity. The parameters investigated are bearing length, diameter, clearance, rotational velocity, ambient pressure, and the gas viscosity and ratio of specific heats. It is shown that, in general, the existing theories of load performance for compressible lubricants, operating in isothermal conditions, give a satisfactory correlation with the experimental results. The half-speed whirl results are not related to a complete analytical theory, but useful stability criteria are established.

GASEOUS STATE

533.7

5047 PARTITION FUNCTION OF AN ATOM IN A SPHERICAL BOX. R.M.Mazo.

Amer. J. Phys., Vol. 28, No. 4, 332-5 (April, 1960).

The density of states of spherical waves used in the calculation of low-temperature second virial coefficients of gases leads to an incorrect result when applied to the partition function of an ideal gas in a spherical box. A more accurate density of states is derived and shown to lead to the correct result. It is argued that the corrections play no role in the calculation of the second virial coefficient, and hence the known results for that case need no revision.

533.7

5048 JOULE–THOMSON EFFECT FOR GASES AND GAS MIXTURES. II. W.Koeppe.

Z. angew. Phys., Vol. 11, No. 11, 432-40 (Nov., 1959). In German.

The effect is calculated using the virial expansion of the ideal gas equation of state. The virial coefficients are calculated by a statistical mechanical method; [Molecular Theory of Gases and Liquids. J.O.Hirschfelder, C.F.Curtiss and R.B.Bird. New York : John Wiley (1954).] using the Lennard-Jones 6-12 potential, with quantum statistical corrections for "light" gases. The numerical results are fully tabulated, and are graphically compared with data for H_2, He, N_2, A, air, and N_2–A, O_2–A, He–A, He–N_2, N_2–H_2 mixtures. Third and higher order virial coefficients are discussed in terms of the difference between calculated and measured values of the effect, and the reduction parameters are found to differ among the gases. P.Gray

533.7

5049 MEASUREMENTS OF THERMAL AND ORDINARY DIFFUSION IN GAS MIXTURES (H_2-He, H_2-N_2 AND H_2-O_2) BY USING ULTRASONICS. A. van Itterbeek and J.Nihoul.

Acustica, Vol. 7, No. 3, 180-4 (1957).

Measurements are carried out on thermal diffusion whereby the change of the concentration is determined from sound velocity measurements. Using the method formulated by Jones and Furry (1946), measurements are made on the change of sound velocity caused by the change of concentration as a function of time, and from this the mutual diffusion coefficient D_{12} can be determined for the different mixtures as a function of temperature. A good agreement is obtained with the values calculated from the equations of Hirschfelder.

533.7

5050 DIFFUSION COEFFICIENT OF ATOMIC HYDROGEN THROUGH MULTICOMPONENT MIXTURES. H.Wise.

J. chem. Phys., Vol. 31, No. 5, 1414-15 (Nov., 1959).

This was measured for atomic H through a mixture of argon and H_2 at 30×10^{-9} mm Hg. The method used is outlined. Results are shown as a function of the mole-fraction of argon, and agree well with theoretical prediction. W.Good

533.7

5051 DIFFUSION COEFFICIENTS, SOLUBILITIES, AND PERMEABILITIES FOR He, Ne, H_2, AND N_2 IN VYCOR GLASS. C.C.Leiby, Jr and C.L.Chen.

J. appl. Phys., Vol. 31, No. 2, 268-74 (Feb., 1960).

The permeability of a Vycor filter (680 cm^2 area and 0.25 mm thick) is given for helium at six temperatures ranging from 299°K to 723°K, for neon and hydrogen at 673°K and 723°K, and for nitrogen at 673°K. The observed values and their temperature dependences are in good agreement with corresponding values for fused quartz reported elsewhere. Values of the diffusion coefficient of these gases in Vycor also were obtained experimentally, enabling calculation of their solubilities. Helium appears to deviate from activated diffusion in Vycor somewhere between 100° and 26°C. Its permeation velocity and diffusion coefficient at 26°C are larger than expected for activated diffusion, while its solubility at 26°C is one-half its value at 100°C. These changes suggest that some structure sensitive diffusion process begins to dominate the activated or solution process at these lower temperatures. Helium flow rates through the filter as high as 2100 mm Hg (0°C) × cm^3/hr at a filter temperature of 450°C and a pressure difference of 35 mm Hg (0°C) were observed. On the basis of observed permeation rates for the above gases, it is estimated that the filtered helium has an impurity content of less than 1/50th of its unfiltered value.

533.7

5052 VELOCITY OF SOUND IN RELAXING GASES. H.J.Wintle.

Nature (London), Vol. 184, 2007-8 (Dec. 26, 1959).

Measurements of sound velocity in air, carbon dioxide and oxygen have been made at atmospheric pressure in the frequency range 100 to 1500 c/s. Specific heats calculated from the results with the aid of the Beattie–Bridgeman equation of state agree with experimental results obtained by the constant flow method. T.S.E.Thomas

533.7 : 536.24

5053 FLOW AT HIGH THERMAL CONDUCTIVITY. M.N.Kogan.

Dokl. Akad. Nauk. SSSR, Vol. 128, No. 3, 488-90 (1959). In Russian.

The subject of this paper is the transmission of heat from the

plane surface of a solid through a flowing gas. If Reynolds' number is large enough a thermal boundary layer can be defined in analogy to the hydrodynamical layer. The differential equations governing the convection of heat may be simplified for this layer by neglecting viscosity terms. In this way a relatively simple formula is obtained for the distribution of the temperature in stationary flow; also an expression for the rate of heat transmission is obtained. If the thermal conductivity increases more and more, convection of heat becomes less important than conduction. In the limit of infinite thermal conductivity the temperature becomes uniform and local perturbations are propagated at the "isothermal velocity of sound". Equations are derived for the convection of heat which may still be important far from the solid surface in the limit of high thermal conductivity. In these equations the "isothermal Mach number" enters as a parameter. All these relations are applicable to plasma and highly ionized gases. R.Eisenschitz

533.7

5054 THERMAL CONDUCTIVITY OF BINARY AND TERNARY MIXTURES OF HELIUM, ARGON AND XENON. S.C.Saxena.
Indian J. Phys., Vol. 31, No. 12, 597-606 (Dec., 1957).

The thermal conductivities of the binary gas mixtures A–He, A–Xe and He–Xe have been determined for various concentrations by using the "hot wire" method. The experimental values of thermal conductivity are in good agreement with the values calculated on the Chapman–Enskog theory for the Lennard-Jones 12-6 model. The experimental data over the entire range of concentration for each mixture have been formulated by means of an empirical equation containing two constants. These expressions will be of great use for gas analysis in the usual experiments on diffusion and thermal diffusion. A simple modification of the Lindsay–Bromley formula (1950) suggested by Srivastava and Saxena (1957) is found to reproduce the experimental data extremely well. The thermal conductivities of the ternary mixtures of argon, helium and xenon have also been measured. The experimental values are found to be in good agreement with those calculated on the basis of a simple formula suggested by Srivastava and Saxena. The latter is obtained as an extension of the formula suggested by Lindsay and Bromley for binary mixtures.

533.7

5055 ELECTRICAL CONDUCTIVITY OF AIR UNDER THE ACTION OF A SHOCK WAVE. J.Thouvenin.
C.R. Acad. Sci. (Paris), Vol. 250, No. 2, 302-4 (Jan. 11, 1960).
In French.

A study is made of the electrical conductivity of air heated by shock waves produced by an explosive charge. Graphs of conductivity against shock speed (between 5000 and 8000 m/s) are derived allowing for and neglecting the formation of nitric oxide; experimental points follow the former curve, indicating the important role of NO^+ ions. A.G.Gaydon

533.7 : 535.3 : 545

INCREASE OF THE SENSITIVITY OF THE OPTICO-ACOUSTIC METHOD OF GAS ANALYSIS BY THE USE OF CELLS EMPLOYING MULTIPLE PASSAGE OF RADIATION. See Abstr. 4752

533.7 : 535.33

5056 EXPERIMENTAL RESEARCHES ON THE CONTINUOUS SPECTRA OF THE RARE GASES. F.Gans.
C.R. Acad. Sci. (Paris), Vol. 249, No. 25, 2764-5 (Dec. 21, 1959).
In French.

The factors affecting the continuous spectrum of the rare gases contained in a discharge tube have been investigated and a qualitative discussion of the observations made is presented. G.I.W.Llewelyn

VACUUM PHYSICS

533.5

5057 SUMMARIZED PROCEEDINGS OF A SYMPOSIUM ON CURRENT DEVELOPMENTS IN THE PRODUCTION OF HIGH VACUA — LONDON, APRIL, 1959. J.Yarwood.
Brit. J. appl. Phys., Vol. 10, No. 9, 383-91 (Sept., 1959).

533.5

5058 THEORY AND DESIGN OF GETTER-ION PUMPS. L.Holland.
J. sci. Instrum., Vol. 36, No. 3, 105-16 (March, 1959).

The theory and design are discussed of getter-ion pumps, in which gas is exhausted by sorption in metal layers in the presence of an ionizing electron stream. The development of getter-ion pumps is traced from the early observations of gas absorption in glow-discharge tubes and sputtered and evaporated deposits. The effects of activating the residual gas by ionization are discussed and it is shown that only a limited number of gas-metal pairs are known where this enhances the sorption rate. Generally, the speeds of oxidizing reactions are not influenced by activation. Inert gases, which cannot be directly sorbed by the getter, may be ionized and their positive ions transported to a target, where they may be embedded or covered by metal films. The sorption and deposition properties of a range of getter materials are surveyed, and it is shown that titanium, barium and calcium may be used in evaporation type pumps. Methods of continuously replenishing the gettering surface by vacuum evaporation and cathodic sputtering in a range of pumps are described. The use of getter-ion pumps with mechanical and diffusion pumps for pre-exhaustion and obtaining very low pressures are discussed, and factors limiting the ultimate pressure considered. The performance of getter-ion pumps is compared with that of diffusion pumps and it is shown that getter-ion pumps may be used where the gas throughout is small, e.g. attaining ultra high vacuum in degassed envelopes and maintaining the vacua in electronic apparatus of limited volume.

533.5

5059 SIMPLE CONSTRUCTION OF GLASS TITANIUM PUMP. P.Schürer and L.Eckertová.
Czech. J. Phys., Vol. 9, No. 6, 753-4 (1959).

A simple titanium getter pump is described which consists of a diode with a tungsten filament and a titanium anode. An anode voltage of 2.5 kV is applied, giving an anode current of 15 mA. On a baked demountable system with a limiting pressure of 10^{-6} mm due to the diffusion pump, a pressure of 2×10^{-5} mm was obtained in 45 minutes with the titanium pump in operation. A pressure of 10^{-6} mm was obtained in 10 minutes using the titanium pump backed by a rotary pump only. Ionic pumping also takes place, serving to remove inert gases. T.Mulvey

533.5

5060 COMBINED VACUUM METER FOR LABORATORY USE. J.Antal and A.König.
Acta phys. Hungar., Vol. 7, No. 1, 117-24 (1957).

The meter is for the range $1–10^{-6}$ mm Hg. Measurements in the range $1–10^{-3}$ mm Hg are carried out by a thermoelectric method using a bridge circuit (with provisions for the protection of the meter). Measurements in the range $10^{-3}–10^{-6}$ mm Hg are based on the principle of cold cathode ionization. The voltage supply is stabilized against line voltage variations by a series resonance circuit containing a ferromagnetic core inductor. A qualitative description of the stabilization is also given.

533.5

5061 BISTABLE BEHAVIOUR OF THE BAYARD–ALPERT IONIZATION GAUGE. G.Carter and J.H.Leck.
Brit. J. appl. Phys., Vol. 10, No. 8, 364-7 (Aug., 1959).

It has been observed that the Bayard–Alpert ionization gauge can possess either of two completely independent and stable modes of operation. The difference appears as variations in the pressure sensitivity of the gauge and complementary changes in the electrical adsorption characteristics of different gases. This bistable behaviour has been consistently observed on three different gauges and is attributed to the electrical charging of the inner surfaces of the gauges as a result of secondary-emission processes. Confirmation of this hypothesis has been made with a metal-screened gauge in which it was possible to control the discharge.

533.5

5062 INVESTIGATIONS ON THE WORKING OF A PALLADIUM PIRANI GAUGE.
P.K.Dutt and S.K.Mukherjee.
Z. angew. Phys., Vol. 11, No. 12, 470-4 (Dec., 1959).

The use of a palladium barrier Pirani gauge for high pressure (10^{-3} torr) leak detection is discussed. Owing to the existence of a hydrogen threshold which depends in a complex manner on the residual pressure, the method is unlikely to detect small leaks. A.H.W.Beck

533.5

5063 DEMOUNTABLE VACUUM SEAL FOR OPERATION AT TEMPERATURES FROM −188°C TO 800°C.
R.Brymner and W.Steckelmacher.
J. sci. Instrum., Vol. 36, No. 6, 278-81 (June, 1959).

A new type of metal gasket vacuum seal is described which depends on a surface-friction effect instead of compression, which is the basis of most seals described so far. Tests have proved the effectiveness of the seal for repeated cycling between −188 and 800°C on flanges of 3 and 5 in. diameter and on a $\frac{1}{2}$ in. vacuum union. The materials used include mild steel or stainless-steel flanges with flat gasket sheets of soft copper, iron, stainless steel or nickel. Other metal gasket vacuum seals are briefly reviewed and the mechanism of sealing is discussed. A table of recommended dimensions for flanges from 3 to 12 in. diameter is also presented.

533.5

5064 BAKEABLE VACUUM SEALS USING ALUMINIUM-WIRE GASKETS. J.Holden, L.Holland and L.Laurenson.
J. sci. Instrum., Vol. 36, No. 6, 281-3 (June, 1959).

The use of aluminium wire as a vacuum seal between steel flanges has been studied. Gaskets made by twisting together the ends of a 22 s.w.g. wire could be baked to 200°C before they leaked on cooling. High temperature working was possible with butt-welded loops of aluminium wire providing the gasket was highly compressed. Such seals did not cold weld but, at baking temperatures above 400°C, the aluminium plastically flowed and adhered to the mating flanges. The "cemented" joint was vacuum tight at low and high temperatures (20-550°C) although the securing bolts became loose after baking. Such a seal leaked only when the aluminium reached its melting point. Information is given on the minimum compression force which must be applied to an aluminium wire in order to form a cemented joint at elevated temperature. Several uses of the aluminium-wire seal are described.

533.5

5065 ELECTRON BOMBARDMENT APPARATUS FOR VACUUM EVAPORATION. J.C.Kelly.
J. sci. Instrum., Vol. 36, No. 2, 89-90 (Feb., 1959).

Simple experimental arrangements are described for the evaporation of tantalum and zirconium from a pendant drop, maintained molten by electron bombardment. The method is clearly of general application and has advantages over existing techniques. Since there is no boat or container there is no possibility of solution of the boat material and consequent contamination of the evaporant. The material to be evaporated is used in wire or rod form; these may be very easily interchanged.

533.5

5066 LARGE SCALE LABORATORY FREEZE-DRYING APPARATUS. P.M.Grant and R.B.Ward.
J. sci. Instrum., Vol. 36, No. 3, 133-4 (March, 1959).

An apparatus is described which will freeze-dry a total of 6 l. of solution distributed in twenty flasks each twenty-four hours, with a minimum of attention and at a low operating cost.

533.5 : 539.23

A SIMPLE DOSE APPARATUS FOR VACUUM DEPOSITION.
See Abstr. 4693

533.5 : 539.18

ISOTOPE SEPARATION IN MOLECULAR PUMPS.
See Abstr. 4161

VIBRATIONS · ACOUSTICS

534.12

5067 EXTENSION OF THE MYKLESTAD MATRIX METHOD TO INCLUDE ROTARY INERTIA AND SHEAR DEFORMATION. H. Saunders.
J. Acoust. Soc. Amer., Vol. 32, No. 3, 409-10 (March, 1960).

An extension to the matrix procedure of Thomson's (1953) adaption to Myklestad's method is formulated to include both rotary inertia and shear deformation. These additions modify the frequency determination especially for the higher modes.

534.12

5068 TRANSVERSE VIBRATIONS IN A RIBBED PLATE SUPPORTED ON ITS EDGES. Y.Jullien.
Ann. Telecomm., Vol. 14, No. 7-8, 161-4 (July-Aug., 1959). In French.

Studies vibrations of plates whose cross-section (and hence also the moment of inertia) varies discontinuously in one direction, at regular intervals, producing a "battlement" shape, similar to that of a train of pulses. The eigenvalues of the motion of such a plate are found by expanding the cross-section function in a Fourier series and then substituting it into the differential equation. Square and rectangular plates are studied. J.K.Skwirzynski

534.12 : 535.41

5069 THE MAKING VISIBLE OF NODES AND THE MEASUREMENT OF THE AMPLITUDES ON VIBRATING METAL PLATES USING AN INTERFERENCE MICROSCOPE. E.Pfende.
Z. angew. Phys., Vol. 11, No. 12, 464-6 (Dec., 1959). In German.

The interference microscope is applied to the demonstration of nodes and antinodes on vibrating metal discs of nickel-copper alloy (Monel). A commercial interference microscope is used. S.Tolansky

534.12 : 535.41

5070 THE MEASUREMENT OF VIBRATION AMPLITUDES WITH INTERFEROMETRIC METHODS. R.Martin.
Arch. tech. Messen, No. 286 (Ref. V 57-3), 231-2 (Nov., 1959). In German.

A brief review of the interferometric methods exploited for the examination of the distribution of nodes and antinodes on vibrating plates. Two-beam and multiple-beam methods are briefly reviewed. Seventeen references are given. S.Tolansky

534.13

5071 AXISYMMETRIC VIBRATIONS OF SHALLOW ELASTIC SPHERICAL SHELLS. A.Kalnins and P.M.Naghdi.
J. Acoust. Soc. Amer., Vol. 32, No. 3, 342-7 (March, 1960).

Contains an exact solution within the scope of the bending theory of shells for axisymmetric vibrations of thin shallow elastic spherical shells. Specifically, the solution is applied to an investigation of the natural frequencies of the free axisymmetric vibrations of spherical shell segments with various edge conditions. Comparison is drawn with previously known results for transverse vibrations of shallow spherical shells, where the effect of longitudinal inertia is neglected.

534.13 : 539.17

5072 VIBRATIONS OF RODS IN PARALLEL FLOW. D.Burgreen.
Nucleonics, Vol. 17, No. 8, 78-9 (Aug., 1959).

Nucleonics Data Sheet No. 33. A graph summarizing the results of an experimental programme on the vibrations of clustered rods cooled by water flowing parallel to the axes of the rods. The data are applicable to fuel rods in nuclear reactors. R.D.Smith

534.15

5073 VIBRATION INVESTIGATIONS ON RAILS IN THE ULTRASONIC RANGE. H.Haeske.
Acustica, Vol. 7, No. 3, 146-50 (1957). In German.

The accelerations in the frequency range from 10 to 100 kc/s experienced by the rail during the passage of a train are measured. The spectrum falls off slowly with rising frequency; this depends only on the type of excitation (as shown by model research). The mode of vibration of the rail is investigated. Dispersion regions appear between 35 and 60 kc/s. A large waviness appears along the rail, ascribed to the superposition of standing waves of many types, and a function of the place of excitation. The attenuation in this frequency range is less than 0.3 dB/m. Electric welds produced an attenuation < 1 dB (thermite welds up to 6 dB) for the progressive waves.

534.15 : 621.317.39

5074 LONGITUDINAL VIBRATION MEASUREMENTS IN THE MEGACYCLE RANGE MADE BY ELECTROSTATIC DRIVE AND FREQUENCY-MODULATION DETECTION.
P.G.Bordoni and M.Nuovo.
Acustica, Vol. 7, No. 1, 1-7 (1957).

The frequency range of the equipment described is about 20 times wider than that of all previous apparatus. Details are given of the frequency-modulation and detection circuits used, together with typical data on their sensitivity and signal-to-noise ratio. The

behaviour of the apparatus is checked in a practical case, for measuring the frequencies of the first eleven longitudinal modes, for an aluminium plate, in the range from 0.5 to 5.5 Mc/s.

534.17

5075 EFFECT OF DAMPING AND VIBRATION DETECTOR POSITION IN RESONANCE MEASUREMENTS. J.A.Ryan.
J. Acoust. Soc. Amer., Vol. 32, No. 3, 408-9 (March, 1960).

Vibrations in a finite-length, thin rod at low frequencies are considered. Two cases are discussed. In the first, the pressure amplitude at the driven end is assumed constant and, in the other, the particle-velocity amplitude is taken as being constant. An oscillatory character to the amplitudes of the resonance peaks is found which is a function of detector position and attenuation. This phenomenon may explain the observed differences in the heights of the resonance peaks, and the recurrence of groups of large and smaller peaks in rods, plates, shells, and other vibrating systems. It may also have a considerable effect on the apparent Q (or bandwidth) of the resonance curves.

534.2

5076 PROPAGATION OF LARGE AMPLITUDE WAVES IN ANNEALED ALUMINUM. J.F.Bell.
J. appl. Phys., Vol. 31, No. 2, 277-82 (Feb., 1960).

An experimental study of large amplitude compression waves in annealed aluminium for the case of constant velocity impact has given a close agreement with the strain rate independent theory of one-dimensional plastic wave propagation. Radial effects in the first diameter are observed and calculations of Poisson's ratio indicate the presence of relatively large dilatation. Propagation velocities, maximum strain, and energy considerations are in agreement with predictions from the slopes of the static stress-strain curve. These data were obtained using the author's diffraction grating technique for measuring strain and surface angle.

534.21

5077 WAVELENGTH OF PLANE WAVES IN A DISSIPATIVE MEDIUM, AND OF SPHERICAL WAVES IN A NON-DISSIPATIVE AND IN A DISSIPATIVE MEDIUM. J.W.Ellis.
Amer. J. Phys., Vol. 26, No. 6, 398-9 (Sept., 1958).

534.21

5078 APPROXIMATION FORMULAE FOR SOME COMMONLY OCCURRING COMBINATIONS OF ACOUSTIC CONDUITS. C.Kleesattel.
Acustica, Vol. 6, No. 3, 288-94 (1956). In German.

Combinations of conduits, consisting of $\lambda/2$ elements, of $\lambda/4$ elements or of $\lambda/2$ and $\lambda/4$ elements are considered. Formulae are given for the forces and velocities on the end faces of the conduit as functions of impedance, internal friction and tuning. The formulae can also be applied to active conduits, e.g. to electro-acoustic transducers and their combinations with passive conduits.

534.22

5079 THE JUMP OF THE SONIC VELOCITY AT BOILING POINT AND ITS CORRELATION WITH THE PICTET–TROUTON RULE. W.Schaaffs.
Acustica, Vol. 6, No. 4, 382-6 (1956). In German.

At the boiling point, the ratio of sound velocity in the liquid phase to that in the vapour phase under atmospheric pressure is approximately 5. This rule for the jump in the sound velocity at the boiling point can be derived from the Pictet–Trouton rule in thermodynamics and is well established experimentally. For oxygen, nitrogen, hydrogen, argon, helium and mercury, the ratio of the Trouton coefficient to the velocity jump has a constant value of about 3.46 cal deg^{-1} mol^{-1}.

534.22

5080 THE JUMP OF THE SONIC VELOCITY AT THE MELTING POINT OF SOME METALS. W.Schaaffs.
Acustica, Vol. 6, No. 4, 387-90 (1956). In German.

By collating previous measurements made in zinc, cadmium, tin, lead, bismuth, mercury, sodium, potassium, caesium and gallium, it is shown that, at the melting point, the ratio of the velocities of longitudinal waves in the solid and liquid phases is about 1.26, and that the ratio of velocity of dilatational waves in the solid phase and of longitudinal waves in the liquid phase is about 1.03 (for practical purposes, 1).

534.22

5081 VARIATION WITH TEMPERATURE OF THE VELOCITY OF SOUND IN METAL BARS.
C.Sălceanu and E.Huschitt.
C.R. Acad. Sci. (Paris), Vol. 249, No. 25, 2731-3 (Dec. 21, 1959). In French.

The velocity of compressional waves in a steel bar (1.7% carbon) is reported approximately inversely proportional to temperature (16°-366° C). H.D.Parbrook

534.22

5082 INFLUENCE OF THE NATURE OF THE WALLS OF AN ACOUSTIC RESONANCE TUBE FOR DETERMINING THE SPEED OF SOUND IN LIQUIDS. C.Sălceanu and M.Zăgănescu.
C.R. Acad. Sci. (Paris), Vol. 249, No. 23, 2509-10 (Dec. 9, 1959). In French.

Short note showing that the resonance in the tube depends upon the acoustic impedance of the tube walls. H.D.Parbrook

534.22 : 532.7

CALCULATION OF SOUND VELOCITY IN ELECTROLYTIC SOLUTIONS. See Abstr. 5013

534.22

5083 SOME EFFECTS OF VELOCITY STRUCTURE ON LOW-FREQUENCY PROPAGATION IN SHALLOW WATER.
A.O Williams, Jr.
J. Acoust. Soc. Amer., Vol. 32, No. 3, 363-70 (March, 1960).

Refractive conditions — variations of the velocity of sound in the water — should alter the pattern of acoustic propagation in shallow water, with respect to the homogeneous case. For small values of H/λ (water depth to acoustic wavelength), wave analysis must replace the more familiar ray treatment. If the bottom material acts like a homogeneous fluid, such changes can be computed, for a certain range of H/λ, by perturbation theory starting from the idealized Pekeris (1948) solution. The changes depend on the fractional change of sound velocity (and its structure) and on $(H/\lambda)^2$. Specific calculations are made for a linear gradient and a simple sound channel, and are, in part, corroborated by a variational calculation. Limitations of the method are stated. If it is further assumed that attenuation of such transmission is proportional to the acoustic intensity near the bottom, downward refraction should lead to attenuation greater than that for isovelocity water. A few comparisons with experiment are presented; agreement is fair.

534.22

5084 ON SHOCK WAVES WHICH ORIGINATE ON "WEAK" INTERFACES. V.Červený.
Czech. J. Phys., Vol. 9, No. 1, 101-11 (1959). In German.

If a harmonic spherical sound wave encounters a plane interface between two fluid media, then, under suitable kinematic circumstances there may arise, besides the reflected and refracted wave, also a shock wave. These shock waves may have considerable amplitudes even if the interface is weak, i.e. if the velocity of the waves in the medium containing the source is only little smaller than that of the wave in the medium without a source. In contrast to previous works on the subject, the present paper deals with shock waves originating on such weak interfaces. P.Roman

534.22

5085 THE EFFECT ON SHOCK WAVES OF [SHOCK-TUBE] CROSS-SECTION VARIATIONS AND OF GRIDS IN SHOCK TUBES. H.Reichenbach and H.Dreizler.
Z. angew. Phys., Vol. 12, No. 2, 62-71 (Feb., 1960). In German.

A simplified one-dimensional theory of shock waves is derived from the conservation laws for mass, momentum and energy and from the equation of state of an ideal gas, dissipation being neglected. The theory is used for deriving the effect of obstacles in the path of a shock wave, in particular of discontinuous narrowing or widening of a shock. The effect of grids is obtained as the effect of a contraction, which is followed by an expansion. Changes in velocity and density at obstacles are computed, results being shown in graphs and numerical tables. The theory is tested experimentally. Part of the measurements agree satisfactorily with computed results; numerous discrepancies, however, show that the simplifying assumptions in the theory are not justified. R.Eisenschitz

534.22 : 531.5

MEASUREMENT OF THE EFFECTS OF PISTON MASS AND BURSTING PRESSURE ON THE MOTION OF A PISTON IN A HYPERSONIC GUN TUNNEL. See Abstr. 4976

534.22

5086 MEASUREMENT OF HIGH INTENSITY STRESS PULSES. J.S.Buchanan and H.J.James.
Brit. J. appl. Phys., Vol. 10, No. 6, 290-5 (June, 1959).

A modified form of the Hopkinson bar technique has been applied to the study of stress pulses produced in a simple explosive-metal system. The results are used to illustrate the kind of information which can be obtained from such an experiment. This includes measurements of the pressure in the detonation wave, the changing shape of the stress pulse induced in the metal and the normal fracture stress of the metal.

534.23

5087 IDEAL FORMS OF ELECTRO-ACOUSTIC TRANSDUCERS AND THE PROPERTIES OF CIRCUITS CONSTRUCTED FROM THEM. F.A.Fischer.
Acustica, Vol. 6, No. 5, 421-4 (1956). In German.

The ideal forms of the four types of electroacoustic transducer are discussed. The properties of the electric quadripole which results from the mechanical coupling of two ideal transducers of similar and opposite classes are investigated.

534.23

5088 ELECTROSTATIC TRANSDUCERS WITH SOLID DIELECTRIC FOR WATERBORNE SOUND. G.R.Schodder and F.Wiekhorst.
Acustica, Vol. 7, No. 1, 38-45 (1957).

The capacitor transducers for waterborne sound described are provided with a solid dielectric consisting either of a thin foil or of a layer of enamel. The capacitor is formed in both cases by a thin layer of metal together with a back plate. Since the surface of the transducers can be given nearly arbitrary shapes, many types of transducer with different directional characteristics can be manufactured. Because of the constancy of their qualities over long periods, electrostatic transducers with solid dielectric are well suitable for calibration purposes. Over a wide range of frequencies — limited only by geometrical dimensions — transducers with a plane back plate have a transmitter sensitivity independent of frequency, while the microphone sensitivity decreases linearly with increasing frequency. A transmitter and a receiver of this kind form a repeater system which is independent of frequency.

534.23 : 620.317.39

5089 MEASUREMENTS ON ELECTROMECHANICAL TRANSDUCERS. H.G.Diestel.
Acustica, Vol. 6, No. 4, 357-60 (1956). In German.

An apparatus for the continuous recording of the frequency curves of electromechanical transducers is described, in which the back-coupling on to the driving system is compensated by a control circuit. The frequency curves of a piezoelectric and electrodynamic detector for vibrations of solids are given as examples. In a gyratory "one-way-system" the relevance of the reciprocity principle is experimentally exemplified.

534.23 : 621.317.39

5090 PIEZOELECTRIC TRANSDUCERS. A.C.Dobelli.
Acustica, Vol. 6, No. 4, 346-56 (1956).

A brief review is presented of the properties and parameters of the most widely used piezoelectric materials, some of which are given in terms of equivalent circuits; next some of the considerations that should be given to the choice of materials and dimensioning of the element for particular applications. A few piezoelectric crystals are characterised which, although not used on a commercial scale, are nevertheless of scientific interest. Some references are given to some recent developments in the field of piezoelectric polycrystalline ceramics.

534.23 : 621.395.61

5091 TRANSDUCERS AND THEIR EQUIVALENT ELECTRIC CIRCUITS; APPLICATION TO MICROPHONES. N.Rouche.
Acustica, Vol. 6, No. 3, 317-23 (1956). In French.

It is shown that a system analogous to that set up by Fischer (see, for example, Abstr. 3223 of 1954) can be established on a general basis. All possible forms of the transducer equations compatible with the conservation of energy are examined from this standpoint.

534.23 : 621.395.62

5092 MAGNETOSTRICTIVE TRANSDUCERS WITH MECHANICAL LOADS. R.R.Whymark.
Acustica, Vol. 6, No. 3, 277-87 (1956).

The influence of mechanical loads upon a window-type magnetostrictor is considered and the deductions checked by measurements. The loads consists of thin stubs either parallel or exponentially tapered. Liquid loads are simulated with high loss structures and optimum loading values are experimentally determined. The results are verified by calculations involving the mechanical Q of the load material. The electromechanical efficiency is measured and an optimum value of 42% is obtained for the mounted magnetostrictor, which agrees closely with the value predicted from the theory. Brief investigations of transducer damping with low loss loads are also performed and the results indicate methods for the basic design of practical transmission systems.

534.23

5093 THERMAL ATTENUATION OF NONLINEAR STRESS WAVES. S.Treitel.
J. appl. Phys., Vol. 31, No. 2, 391-5 (Feb., 1960).

The work of Knopoff and MacDonald (Abstr. 3236 of 1958) on the attenuation of nonlinear stress waves in solids was extended to include thermal losses. The damping of a nonlinear stress wave is completely describable in terms of two attenuation coefficients, a "mechanical coefficient α_1, and a "thermal" coefficient α_2. The latter is probably small compared to the other, but much high-precision experimental work is required to settle this point definitely.

534.23

5094 THE "DIVERGENCE" ATTENUATION IN THE PROPAGATION OF SOUND IN THE SEA. G.Pazienza.
Elettrotecnica, Vol. 46, No. 12, 860-4 (Dec. 10, 1959). In Italian.

An analytical method is given for calculating the attenuation of sound in a medium consisting of a series of layers, each having zero horizontal velocity gradient and constant vertical velocity gradient.
V.G.Welsby

534.23

5095 ULTRASONIC ABSORPTION IN POLYCRYSTALLINE SELENIUM. H.Gobrecht and H.Hamisch.
Acustica, Vol. 7, No. 1, 17-20 (1957). In German.

The absorption coefficient for longitudinal ultrasonic waves of 3 Mc/s in polycrystalline selenium is determined (at 2.2 cm^{-1}) by temperature measurements during the passage of the sound. This rather strong absorption is caused by the piezoelectric properties of the selenium. The sound waves produce piezo-alternating voltages, that produce electric losses because of the electric conductivity of the selenium. These losses take energy from the sound wave. Because of the electric losses, an absorption law of the form $I = I_0 \exp(-\alpha x)$ obtains. The absorption coefficient α is calculated from the piezoelectric modulus d_{11}, the conductivity of the selenium in the x-direction, the impedance to the sound, the dielectric coefficient and the frequency. Alternatively absorption measurements in polycrystalline selenium can be used for the determination of the conductivity of the crystallites in the x-direction.

534.23

5096 ULTRASONIC ABSORPTION IN ACETIC ACID AT 450 kc/s BY THE CALORIMETRIC METHOD. S.Parthasarathy and V.N.Bindal.
Nature (London), Vol. 184, 631 (Aug. 22, 1959).

At 30°C α/ν^2 was found to be $90\,000 \times 10^{-17}$ cm^{-1} $sec^2 \pm 10\%$.
J.Jarzynski

534.23 : 539.4

EFFECT OF ULTRASONIC RADIATION ON THE CREEP OF COPPER SPRINGS. See Abstr. 4563

534.26

5097 ACOUSTIC FORCES AND TORQUES ON A SYSTEM OF STRIPS. K.Særmark.
Appl. sci. Res. B, Vol. 8, No. 1, 13-28 (1959).

Continuation of Abstr. 10719 (1959). Numerical calculations are presented for the case of two coplanar strips with the parameter $kb = 1$ and an arbitrary angle of incidence. Simple expressions for the forces and torques are derived. These relate the forces and torques of the present problem to those acting on a single strip, present alone in an unlimited radiation field.

534.26 : 538.56

SINGULAR INTEGRAL EQUATIONS THEORY OF TWO-DIMENSIONAL DIFFRACTION PROBLEMS. See Abstr. 3857

534.26

5098 SCATTERING OF SOUND BY SOUND. J.L.S.Bellin and R T.Beyer.

J. Acoust. Soc. Amer., Vol. 32, No. 3, 339-41 (March, 1960).

An attempt was made to determine the presence of scattering resulting from the nonlinear interaction of two finite-amplitude sources, operating in water. Experiments were performed with two beams crossed at right angles and also in the nonperpendicular case. A detector crystal, tuned to the summation frequency (13.4 Mc/s) of the two sources (7.4 Mc/s and 6.0 Mc/s), and pivoted about a point above the interaction region, was used to investigate the scattered field. The results indicated no scattered sound above the noise level of the detection system. The lack of scattered sound is in agree ment with the theoretical considerations of Westervelt (Abstr. 4084 of 1957) but is contrary to the predictions of Ingard and Pridmore-Brown (Abstr. 4272 of 1956).

534.26

5099 SIDE SCATTERING OF SOUND IN SHALLOW WATER. R.J.Urick.

J. Acoust. Soc. Amer., Vol. 32, No. 3, 351-5 (March, 1960).

When a sound beam travels through the sea, it is scattered in all directions by inhomegeneities of various sorts in the sea and on its boundaries. In the backward direction, the aggregate of all the scattered contributions is called "reverberation". In other directions, the "side-scattering" can be studied by using two directional transducers, trained so that the beams cross each other, to measure the sound scattered out of one beam and received on the other. This method was employed in an off-shore area in the Gulf of Mexico having a particularly uniform bottom. Using two bottomed transducers a mile and a half apart, the intensity of scattering was measured at 22 kc/s for different angular orientations of the two beams. The measurements were reduced to the coefficient, scattering strength, without requiring either transducer calibrations or direct measurements of transmission loss. The results indicate a bottom scattering strength between –30 and –40 dB having no appreciable dependence on angle between the two beams. Within the angular range from the backward direction around to 150° in the forward direction, the scattering appears isotropic. This indicates that isotropic bottom scattering may be safely assumed in applications utilizing separated transmitting and receiving transducers at kilocycle frequencies.

534.4

5100 ENERGY VARIATION WITH PRESSURE AND TEMPERATURE IN A SONIC STATIONARY WAVE. A.R.Ingles.

Brit. J. appl. Phys., Vol. 10, No. 6, 246-50 (June, 1959).

Using stationary waves in air, carbon dioxide and coal gas, the variations of the energy per wave per unit area E with pressure p at different temperatures have been plotted, and a relationship of the form $E = Kp^n$ obtained for a limited pressure range. The importance of correct impedance matching between the source and the surrounding gas is emphasized by the results.

534.4

5101 DETERMINATION OF FINITE AMPLITUDE DISTORTION BY LIGHT DIFFRACTION. B.D.Cook.

J. Acoust. Soc. Amer., Vol. 32, No. 3, 336-7 (March, 1960).

The theory of a new optical method of determining the harmonic structure of progressive ultrasonic waves undergoing finite amplitude distortion is developed using Fourier transforms. The waveform is determined by measurement of the light intensity of all the orders in the diffraction pattern.

534.5

5102 PHYSICAL EQUIVALENTS OF SPECTRAL NOTIONS. H.M.Trent.

J. Acoust. Soc. Amer., Vol. 32, No. 3, 348-51 (March, 1960).

The notion of a Fourier spectral equivalent of an arbitrary function has been known for a long time in its basic mathematical form. Calculations of these spectral quantities are conventionally based on the Fourier integral. It is not so well known that the Laplace transformation also yields a spectral notion of which the Fourier form is a special case. In addition, vibration engineers have made extensive use in recent years of the concept of a shock spectrum. Simple physical experiments are described which yield direct quantitative spectral values at specified frequencies for any of the three spectra mentioned in the foregoing. These equivalents are useful in assigning physical significance to the quantities under discussion.

534.6

5103 A GRAPHIC METHOD OF DETERMINING LOUDNESS AND LOUDNESS LEVEL FROM THE "THIRD-OCTAVE" LEVEL DIAGRAM. E.Zwicker.

Frequenz, Vol. 13, No. 8, 234-8 (Aug., 1959). In German.

Using objective third-octave level measurements in a plane sound field a series of diagrams are reproduced from which the loudness and iso-loudness levels of similar sounds can be determined. Four diagrams allow the determination of loudness level and loudness in the frequency range 45 c/s to 14 kc/s and "third-octave" level ranges 10-50 dB, 20-70 dB, 40-90 dB and 60-110 dB. A fifth diagram illustrates the application to a tabulated series of measured "third-octave" levels. Reference is made to a paper by Zwicker, Flottorp and Stevens (Abstr. 8493 of 1957). A.B.Wood

534.6

5104 LOW REFLECTION SOUND MEASURING ROOMS. W.Bausch and R.Schubert.

Frequenz, Vol. 13, No. 10, 324-31 (Oct., 1959). In German.

The paper deals with the acoustic characteristics of anechoic measuring rooms. Reference is made to similar work by Meyer et al. [Akustische Zeitschrift, Vol. 5, 352-64 (1940)] and Kurtze (Abstr. 5636 of 1952). Records showing the reduction of sound-level with increase in the distance from the sound source in various anechoic rooms are presented. The recorded curves show the departures of the sound levels from the r^{-1} law at frequencies of 80, 100, 320, 1000 and 2500 c/s. The design of absorbent spikes and wedges, particularly as regards spike or wedge shape, is considered. A.B.Wood

534.6

5105 GENERAL THEORY FOR THE SYNTHESIS OF HYDROPHONE ARRAYS. H.S.Heaps.

J. Acoust. Soc. Amer., Vol. 32, No. 3, 356-62 (March, 1960).

An acoustic signal pressure and a noise background are supposed incident upon a general array of hydrophone elements whose individual outputs are combined in a linear manner by means of amplifiers and time delays. Determination is made of the optimum spatial distribution of the hydrophone elements, and also the optimum combination of their outputs, in order to produce in the combined output a maximum value of peak signal in relation to the average noise background. The incident signal is not restricted to be a continuous wave of a single frequency.

534.6

5106 ACCURATE COUPLER PRESSURE CALIBRATION OF CONDENSER MICROPHONES AT MIDDLE FREQUENCIES. T.F.W.Embleton and I.R.Dagg.

J. Acoust. Soc. Amer., Vol. 32, No. 3, 320-6 (March, 1960).

The technique whereby the reciprocity theorem is applied to the determination of the pressure sensitivities of microphones was modified to improve the reliability and accuracy of the measurements. Sensitivities are measured in terms of the volume of a cavity, the capacity of a fixed condenser, and the variable setting of an accurate potentiometer. Six different pairs of measurements are made instead of three, which is the minimum possible number: this enables a check to be made on the internal consistency of each calibration. The accuracy of the measured sensitivities is estimated to be ± 0.05 dB on an absolute scale and ± 0.03 dB relative to each other. This technique was employed to measure the properties of several condenser microphones of each of three well known types over periods ranging from five months to two years. Results are given for their temperature and pressure coefficients, effective volumes due to nonrigidity of their diaphragms and drift with the passing of time.

534.6 : 621.395.623.7

5107 MEASUREMENT OF AMPLITUDE AND PHASE DISTRIBUTION ON CONICAL LOUDSPEAKER DIAPHRAGMS. F.Eggers.

Acustica, Vol. 7, No. 1, 21-8 (1957). In German.

A continuous record of amplitude and phase over the whole conical diaphragm of a loudspeaker was made. Whereas the motion at low frequencies is of the piston type, at moderate frequencies azimuthal variations, and at higher frequencies radial variations,

become apparent. With warble tones or noise bands, a ring zone of maximum amplitude appears on the membrane, which moves towards the centre as the frequency goes up. The piston type vibration is more important for radiation at low and middle frequencies, the azimuthal flexural waves superposed thereon having little effect.

534.6 : 621.395.623.7 : 621.317.39

5108 AUTOMATIC RECORDING OF CURVES OF EQUAL PHASE SHIFT. V.Gavreau and A.Calaora.
Acustica, Vol. 6, No. 6, 539-42 (1956). In French.

An automatic apparatus for tracing these curves in a plane section of a three-dimensional sound field is described. This is applied to the sound field of a loud-speaker and to the effects of interposed obstacles. The sound waves so observed have peculiar shapes; they appear as lenticular chaplets, rather like those obtained in photo-elastic studies.

534.6

5109 DETERMINATION OF THE SIZE OF DEFECTS BY THE ULTRASONIC IMPULSE ECHO METHOD.
J.Krautkramer.
Brit. J. appl. Phys., Vol. 10, No. 6, 240-5 (June, 1959).

Much to the detriment of ultrasonic testing and all attempts at standardization, it is not yet possible to compare the results from different kinds of equipment regarding the echo of a back wall or a small defect. In order to facilitate this, the relations between echo height, distance and size of circular disc defects are brought into simple and universally applicable forms. It is shown that the first back echo of a simple plate is the most convenient reference echo. With the help of a calibrated gain control as accessory to a usual flaw detector and a graphical representation of the formulae, an equivalent circular disc defect can be attributed to the actual defect. The influence of curved contact and back wall surfaces, and the application of the method for determining ultrasonic attenuation in thick specimens, is discussed.

534.8

5110 THE FUNDAMENTALS OF THE VIBRATIONAL TREATMENT OF MOLTEN METALS.
H.J.Seemann and H.Staats.
Acustica, Vol. 6, No. 4, 325-34 (1956). In German.

It is concluded that the most satisfactory methods of exciting u.s. waves in molten metals are electrodynamic. A comparison is made of different electrodynamic set-ups, based on an approximate calculation of their efficiencies. The effects are discussed of the damping properties of the crucible material, and apparatus for investigating these properties is described.

534.8 : 541.18

EFFECT OF SOUND INTENSITY ON DISPERSION AND COAGULATION IN ULTRASONIC EMULSIFICATION. See Abstr. 4737

534.81

5111 HUMIDITY OF THE AMBIENT AIR: AN IMPORTANT FACTOR IN THE RESPONSE OF A GUT STRING.
E.Leipp.
C.R. Acad. Sci. (Paris), Vol. 249, No. 20, 2014-16 (Nov. 16, 1959). In French.

Experiments to determine the variation of frequency of vibrating strings of steel, nylon and gut as a function of the humidity of the ambient air are described. The frequency of nylon strings was practically constant over a range of 30 to 90% relative humidity, whereas in this range the frequency of strings of gut fell (e.g. from 1960 to 1640 c/s). A varnished gut string on the other hand remained constant in frequency over this range of humidity. The law of frequency variation of the unvarnished gut strings is practically linear. The results explain the preference of professional musicians for strings of nylon (for guitar) and steel (for violin, cello etc.).
A.B.Wood

534.81

5112 THE "OCTAVE VIBRATION", SENSITIVE PARAMETER IN THE SPECTRUM OF STRINGED INSTRUMENTS.
É.Leipp.
C.R. Acad. Sci. (Paris), Vol. 249, No. 16, 1474-6 (Oct. 19, 1959). In French.

Experiments with 14 different violins playing under varying conditions have shown that 112 out of 154 spectra obtained confirm a former result that the amplitude of the second harmonic is equal to or greater than that of the fundamental. The physical cause of this is investigated, and a mechanism is found whereby a vibrating string can effectively excite a vibration of double its frequency at its point of attachment. This "octave vibration" mode is in addition to the transverse, longitudinal, and torsional modes.
G.M.Brown

534.81

5113 THE PROBLEM OF VIBRATION PRODUCTION FROM THE POINT OF VIEW OF NEW MUSICAL INSTRUMENT RESEARCH AND DEVELOPMENT. R.Bierl.
Frequenz, Vol. 13, No. 8, 250-62 (Aug., 1959). In German.

Deals with the mechanism of self excitation of vibrations in musical instruments (a) purely mechanical, e.g. stringed instruments, wind instruments (clarinet, oboe, saxophone), the human voice, etc., (b) electrically excited vibrations, (c) overtones in mechanical vibration generators.
A.B.Wood

534.81

5114 ELECTRONIC MUSIC SYNTHESIS.
H.F.Olson, H.Belar and J.Timmens.
J. Acoust. Soc. Amer., Vol. 32, No. 3, 311-19 (March, 1960).

The modern systems of communication were applied to the electronic synthesis of music in the form of the electronic music synthesizer. The electronic music synthesizer is a machine which provides means for producing a tone with any frequency, intensity, growth, duration, decay, portamento, timbre, vibrato, and deviations. If these properties of a tone are specified, the tone can be produced by the synthesizer from a coded record. For implementing the electronic synthesis of music an improved and enlarged electronic music synthesizer Mark II was developed and built. The new electronic music synthesizer and the use of the new synthesizer by professional musicians will be described.

534.84

5115 THE ACOUSTICS OF LARGE HALLS.
R.Lamoral.
Acustica, Vol. 7, No. 2, 117-21 (1957). In French.

In large auditoria, the shape has a very marked effect on the acoustics, and the homogeneity of the sound field depends on the position of the source and the type of usage to which it is subjected (symphony orchestra, music hall, lectures, etc.). Nevertheless, in all cases, it is worth while to consider separately the audition region (listeners or microphones) and the zone of the source. These factors are discussed.

534.84

5116 REVERBERATION TIME CHARACTERISTICS OF SEVERENCE HALL.
H.J.Ormestad, R.S.Shankland and A.H.Benade.
J. Acoust. Soc. Amer., Vol. 32, No. 3, 371-5 (March, 1960).

Following the changes in the acoustical conditions made in Severance Hall during the summer of 1958 (see Abstr. 9354 of 1959) a series of reverberation time measurements were made during the 1958-1959 concert season of the Cleveland Orchestra. Measurements were made in the empty hall, in the hall with orchestra during rehearsals, which is also the condition for recordings, and with a full audience during the symphony season. Measurements were made of 38 mm calibre revolver shots, of fully orchestrated chords played at rehearsals and of the endings of movements in a symphony (Mendelssohn No. 4 in A major) and a concerto (Dvorak B minor, Op. 104) during concerts. The results show a considerable increase in the reverberation time at all frequencies as compared to the conditions existing prior to 1958. The present reverberation time with a full audience is about 1.7 sec in the mid-frequencies and rises steadily to well above 2 sec at lower frequencies. Due to the heavily upholstered seats in Severance Hall the sound absorption increment on account of a full audience is unusually low. Measurements made during rehearsals have permitted a determination of sound absorption by the orchestra. Reverberation times measured with microphone pickup on the main floor, in box seats, and in the balcony, are essentially the same. The measurements will be continued during the 1959-1960 concert season, especially to determine the effects of a new humidity control system which was installed during the summer of 1959.

534.84

5117 MEASUREMENTS OF THE SOUND ABSORPTION COEFFICIENT AND THE SOUND TRANSMISSION LOSS AT THE KOBAYASI INSTITUTE OF PHYSICAL RESEARCH.
K.Sato and M.Koyasu.
J. Acoust. Soc. Amer., Vol. 32, No. 3, 376-9 (March, 1960).

During the past three years, five reverberation chambers were constructed. These chambers are now used for the measurements of the sound absorption coefficient and the transmission loss. Chamber No. 1 has a volume of 513 m^3 surrounded by nonparallel walls, and the reverberation time of this chamber is greater than 20 sec at 500 c/s. In this chamber, the position of the microphone and test specimens does not affect the absorption coefficient. Chambers No. 3 and No. 4, which are used for transmission loss measurements, have a volume of 164 m^3, respectively. The shape of these chambers is similar to chamber No. 1. The opening between these two chambers is 3.3 m by 3.3 m. Under chamber No. 4, there is chamber No. 5, which is used for the receiving room for impact sound transmission loss measurements.

534.84

5118 SOME EXPERIMENTS IN A ROOM AND ITS ACOUSTIC MODEL. A.F.B.Nickson and R.W.Muncey.

Acustica, Vol. 6, No. 3, 295-302 (1956).

Experiments are described in which the acoustic behaviour of a space about 14 × 5 × 3 m^3 in the octave about 200 c/s is compared with that of a model at one quarter scale, and it is shown that, for several of the well-known objective acoustic tests, the theory that such models are possible is supported. The accuracy attained corresponded with the accuracy with which the surfaces were matched, and was considerably greater than that of the relation of objective testing and subjective impressions.

534.84

5119 SOUND ABSORPTION OF SIMPLE RESONATORS FOR OMNI-DIRECTIONAL SOUND INCIDENCE AND FOR THE ARRANGEMENT IN A LINE, IN THE MIDDLE OF THE ROOM, ON THE WALL, IN THE ANGLE OR CORNER OF THE ROOM. W.Wöhle.

Hochfrequenztech. u. ElektAkust., Vol. 68, No. 2, 56-61 (July, 1959). In German.

A continuation of earlier work on the use of Helmholtz-type resonators to absorb sound, (see Abstr. 4485 of 1955, 5744 of 1956, and 1023 of 1960), and deals theoretically with resonators of this type disposed in different positions in a room; centre, walls, wall angles and corners. A.B.Wood

534.84

5120 TRANSMISSION OF IMPACT NOISES BY FLOATING FLOORS. M.Foti.

Acustica, Vol. 7, No. 1, 29-37 (1957). In French.

Theoretical results are presented for floors with floating slabs, on the assumption of equal boundary conditions for floor and slab. The shock is represented by a Fourier series, by summing the terms of which the acoustic energy transmitted to the auditorium is calculated. A simple system consisting of a single plate is compared from this point of view with a coupled system (two plates elastically coupled). The final formula brings in the characteristics of the two plates and the layer between them. It seems possible to predict the improvement to be attained with specific constructions from tests on small specimens, avoiding costly and tedious full-scale experiments.

534.84

5121 RESONANT SOUND-ABSORBERS. S.N.Rževkin.

Czech. J. Phys., Vol. 9, No. 1, 16-28 (1959). In French.

After an introductory summary of the history of the use of resonators in architectural acoustics the paper discusses the following topics: (1) the possibility of total absorption of sound by resonant cavities; (2) resonant absorbers in multiple layers; (3) resonant absorbers in the diffuse sound field of a room, and (4) resonant absorbers in practical applications. A.B.Wood

OPTICS . PHOTOMETRY

535.1

5122 AN INVESTIGATION CONCERNING THE CLASSICAL FLUCTUATION OF LIGHT. G.Graff and L.Jánossy.

Acta. phys. Hungar., Vol. 10, No. 3, 291-300 (1959).

The work of Abstr. 8499 (1957) is extended to the case where the individual atoms emit different frequencies.

535.1

5123 FLUCTUATIONS IN PHOTON STREAMS. P.Fellgett, R.C.Jones and R.Q.Twiss; C.W.McCombie.

Nature (London), Vol. 184, 967-9, 969-70 (Sept. 26, 1959).

A discussion of the conditions under which the conflicting fluctuation formulae of Jones and Fellgett (Abstr. 6970 of 1957) and Hanbury-Brown and Twiss (Abstr. 6971 of 1957; 2932 of 1958) are valid indicates that the former is correct generally when the detector is at the temperature of the surrounding radiation field whilst the latter is correct in the limit when the detector is too cool to radiate appreciably. In McCombie's paper, a quasi thermodynamical method is applied to a particular model in which account is taken of stimulated emission. The result agrees with the formula of Hanbury-Brown and Twiss and also supports the standard formula for the limiting sensitivity of radiation detectors. G.A.Chisnall

535.1 : 537.533

5124 FLUCTUATIONS OF PHOTON BEAMS: THE DISTRIBUTION OF THE PHOTO-ELECTRONS. L.Mandel.

Proc. Phys. Soc., Vol. 74, Pt 3, 233-43 (Sept., 1959).

The probability distribution p(n, T) of the number of counts n from a photoelectric detector illuminated by coherent light for a time T is studied, by associating photons stochastically with Gaussian random waves. The cumulants of the distribution are derived and it is shown to be of the expected form for a boson assembly in a limited volume of phase space. The distribution depends strongly on the degeneracy of the light beam. It approaches the Poisson form for classical particles at low degeneracies and the distribution characteristic of classical waves at high degeneracies. The analysis leads, incidentally, to an expression for the extent of the unit cell of phase space in the direction of the beam. It is argued that this should be adopted as the measure of coherence length.

535.1

5125 ON THE ROLE OF GROUP VELOCITY OF LIGHT EMITTED IN A REFRACTIVE MEDIUM. I.M.Frank.

Zh. eksper. teor. Fiz., Vol. 36, No. 3, 823-31 (1959). In Russian.

The emission of light by a system of particles possessing an arbitrary proper frequency is considered for the case where the system uniformly moves in a refractive medium which is transparent for the emitted light. The role of the group velocity of the light emitted by such a source is investigated.

535.22 : 530.12

CONSTANCY OF THE VELOCITY OF LIGHT. See Abstr. 4932

535.24

5126 EQUI-DENSITOMETRY. METHOD OF TWO-DIMENSIONAL PHOTOMETRY AND IMAGE ANALYSIS. W.Krug.

Arch. tech. Messen, No. 283 (Ref. V 434-8), 157-60 (Aug.); No. 286 (Ref. V 434-9), 227-30 (Nov., 1959). In German.

A general account of the various methods used for tracing the lines of equal density in a photographic record, e.g. of an interference pattern or a spectrogram. Photographic methods depend on comparison with a density wedge; another method depends on the increase in thickness of an exposed area on a photographic plate. Electronic methods can be used to trace directly lines of equal intensity in a real image formed by an optical system. J.W.T.Walsh

535.24

5127 CONTOUR MAPPING MICRODENSITOMETER. P. Hariharan and M.S.Bhalla.

J. sci. Instrum., Vol. 36, No. 4, 192-5 (April, 1959).

It is basically a scanning microdensitometer in which a gating circuit is utilized in conjunction with an optical printing system to plot automatically a contoured density map of the photograph which is being scanned. The gating circuit used is comparatively simple and extremely stable and permits the insertion of as many contours as are required, at specified values of density.

535.24 : 531.71

RECORDING PROJECTION MICROMETER FOR DENSITOMETRY. See Abstr. 4982

535.24

5128 DAY-LIGHTING EQUATIONS FOR A STANDARD OVERCAST SKY. T.N.Seshadri.

Curr. Sci., Vol. 28, No. 12, 484-5 (Dec., 1959).

Gives formulae for the illumination from a vertical rectangular

source with a luminance distribution like that of the conventional overcast sky. Three formulae are given respectively for a horizontal surface, a vertical surface parallel to the source and a vertical surface at right angles to the source. J.W.T.Walsh

535.24

5129 SPECIAL TYPE OF GRATING, POSSESSING THE PROPERTIES OF A NEUTRAL FILTER FOR USE IN HOMOCHROMATIC PHOTOMETRY.
G.M.Sreekantath and C.A.Verghese.
J. sci. Instrum., Vol. 36, No. 1, 37 (Jan., 1959).

A transmission grating having wedge-shaped opaque and transparent elements is described. It is shown that it has the properties of a truly neutral filter and can be used in homochromatic photometry in the place of a rotating sector disk which is difficult to operate. This new optical device may be particularly helpful when it is desired to change the intensity of a beam of light by very small amounts. It may also find useful application in absorption spectroscopy.

GEOMETRICAL AND INSTRUMENTAL OPTICS
SPECTROSCOPY

(Optical spectra and their analysis are included under the appropriate heading, e.g. Atoms, Molecules, Solid-State Physics, etc.)

535.3 : 537.533

5130 THE REFLECTION OF LIGHT ON TRANSPARENT PHOTOCATHODES. Z.Náray and M.Tóth.
Acta phys. Hungar., Vol. 7, No. 4, 379-83 (1957).

A comparative method was used, in which the absolute value of the common reflection coefficient of the cathode and glass envelope could be determined. For the photomultiplier type RCA 5819 a comparatively high reflection (30 per cent) was found at the maximum sensitivity.

535.3

5131 ATTENUATION OF LIGHT BY WOOD SMOKE. W.W.Foster.
Brit. J. appl. Phys., Vol. 10, No. 9, 416-20 (Sept., 1959).

On the basis of experimental observations of the optical properties of wood smoke particles in bulk and in their natural form as spherical droplets, it is shown theoretically that the attenuation of light by wood smoke results mainly from scattering by the droplets, the effects of absorption being negligible. Other experimental observations on the effective optical density of wood smoke up to high mass concentrations lead to a calculation of the mean effective radius of the wood smoke particles. The Lambert–Beer law appears to hold over the whole experimental range, in accordance with a theoretical estimate of its limits of validity for the conditions used.

535.3

5132 ON THE ENERGY BALANCE IN THE OPTICS OF METALS. Z.Knittl.
Czech. J. Phys., Vol. 9, No. 2, 133-45 (1959).

Some obscurities in the interpretation of the electro-magnetic formulae for reflection and transmission of light at a metal–dielectric boundary are clarified. In particular, it is shown why the principle of reversibility fails when applied to such a boundary.
L.Pincherle

535.3

5133 SIMPLIFICATION OF THE FORMULAE FOR CALCULATING THE OPTICAL CONSTANTS OF ABSORBING MATERIALS. A.Vaško.
Czech. J. Phys., Vol. 9, No. 1, 125-7 (1959). In German.

A simplified method is described for the derivation of formulae for the reflectivity and the absorption coefficient in terms of the measured transmissions, reflectivities and thickness of a thick layer. The formulae given reduce the labour for computing the constants.
S.Tolansky

535.3

5134 USE OF AN INTEGRATING SPHERE TO DISTINGUISH BETWEEN ABSORPTION AND SCATTERING IN SOLIDS. J.A.Bastin, E.W.J.Mitchell and J.Whitehouse.
Brit. J. appl. Phys., Vol. 10, No. 9, 412-16 (Sept., 1959).

In transmission measurements on plane-parallel specimens, light might be lost by absorption or scattering. A method is described in which measurements are made with the same plane-parallel specimen in an integrating sphere. Comparison of the two sets of results allows a quantitative distinction to be made between absorption and scattering. The method is illustrated by some measurements on quartz and diamond.

535.3

5135 THE FORWARD SCATTERING OF LIGHT BY SPHERES ACCORDING TO GEOMETRICAL OPTICS
J.McK.Ellison and C.V.Peetz.
Proc. Phys. Soc., Vol. 74, Pt 1, 105-23 (July 1, 1959).

If the light scattering by transparent spheres is calculated according to geometrical optics a large part of the scattered flux falls within a cone of half-angle $|m-1|$ radians around the forward direction, where m is the refractive index of the sphere relative to the surrounding medium. For many purposes it is this light which is of principal interest. If $I(\theta)$ is the intensity scattered at angle θ and $\Delta E(\theta)$ the flux scattered within this angle, the light externally reflected (I_1) and that transmitted without internal reflection (I_2) normally predominate in the forward-scattered light. For $0.75 \leq m \leq 2$ graphical methods of obtaining I_1 and I_2, and ΔE_1 and ΔE_2, are given: this is made possible by plotting I_1, I_2, and ΔE_1, ΔE_2, against functions of single variables which themselves depend on m and θ. For light internally reflected once (I_3) or twice (I_4) analytical expressions are not given, but the values over which they range are indicated. Light internally reflected more than twice is is shown to be negligible. The accuracy obtainable is within about 1% in each case, and the angular range over which approximation is possible increases as $|m-1|$ increases as long as $m < 1.65$: if $m > 1.65$ the range decreases as m increases. For more accurate computation exact expressions for I_1 and I_2, in terms of m and θ only, are given. Unless $m \gg 1$, $I_2(\theta) \gg I(\theta)-I_2(\theta)$ for small values of θ, and consequently if accurate values of I_1 and I_2 are combined with approximations to I_3 and I_4 the overall accuracy is fairly high. To simplify the computation, from the approximations given, of I and ΔE respectively two tables show the procedures suggested in each case.

535.31

5136 NUMBER OF IMAGES PRODUCED BY MULTIPLE REFLECTION. V.M.Kulkarni.
Amer. J. Phys., Vol. 28, No. 4, 317-18 (April, 1960).

The number of images obtained by multiple reflection by two inclined plane mirrors is not, in general, independent of object position. Also, there is no single formula giving the number which holds good for every angle between the mirrors. One of the four rules laid down in this article can meet any general case with regard to the angle between mirrors or the object position.

535.31

5137 MIRROR-IMAGE KINEMATICS. J.S.Beggs.
J. Opt. Soc. Amer., Vol. 50, No. 4, 388-93 (April, 1960).

A matrix [M] is derived for a system of plane first-surface mirrors which transforms a point or the direction cosines of a ray in the image space to the object space. If the general displacement of the mirror system is represented by the screw matrix [S], then the new position of a point image is given by the transformation $[S][M][S]^{-1}$. This method facilitates designing the mirror supporting structure for minimum image shift due to structural deflections.

535.31

5138 THE EQUIVALENT THICKNESS OF AN ABSORBING LENS. A.Biot.
Ann. Soc. Sci. Bruxelles I, Vol. 73, No. 3, 363-72 (1959). In French.

A method is given for calculating the thickness of a plane parallel plate of the same material as the lens to have the same total light transmission.
W.T.Welford

535.31

5139 APLANATIC LENSES. A.K.Head.
Proc. Phys. Soc., Vol. 74, Pt 6, 731-6 (Dec., 1959).

A differential equation is obtained for the shape of an aspherical lens which is aplanatic for an object at infinity. Numerical integration of this equation for a range of lenses shows the variation in

the shape and properties of such a lens for a range of adjustable parameters. A differential equation is also derived for the shape of a lens which exactly corrects the spherical aberration and coma of an arbitrary optical system.

535.31

5140 APLANATIC CEMENTED DOUBLET DESIGN. M.G.Dreyfus, R.E.Bishop and J.E.Moorhead.
J. Opt. Soc. Amer., Vol. 50, No. 4, 375-8 (April, 1960).

A general method is described for choosing combinations of two optical glass types for the design of an achromatic cemented doublet lens which is required to yield specified amounts of third-order spherical and comatic aberration. Data are presented indicating the preferred crown glasses for use with 605380 and 689309 flint glasses, as typical illustrations of the qualitative aspects of the group of preferred crown glasses for use with a given flint. Formulae are given for computing the doublet radii from the glass constants.

535.31

5141 METHODS OF MEASURING THE AXIAL ALIGNMENT OF OPTICAL SYSTEMS. K.Schuch.
Optik, Vol. 16, No. 10-11, 652-9 (Oct.-Nov., 1959). In German.

Three arrangements, all depending on observations of images reflected from individual refracting surfaces, are described. In the first two accuracy is limited by the accuracy of mechanical slides but in the third this is not so and a precision of one micron in measuring displacement of centres of curvature is claimed.
W.T.Welford

535.31 : 518

5142 LENS DESIGNING BY ELECTRONIC DIGITAL COMPUTER. II. M.Nunn and C.G.Wynne.
Proc. Phys. Soc., Vol. 74, Pt 3, 316-29 (Sept., 1959).

For Pt I see Abstr. 6693 (1959). The method of "successive linear approximation at maximum steps", described in Pt I, has been applied to automatic lens designing on an electronic digital computer. A description is given of the form of programme used and the results of applying the method to three design problems are quoted.

535.31

5143 THE ACCURACY OF THE DUPLIGRAM METHOD FOR TESTING PHOTOGRAPHIC OBJECTIVES. J.Camus.
Optik, Vol. 16, No. 10-11, 632-46 (Oct.-Nov., 1959). In German.

The dupligram is obtained by superposing Twyman-Green interferograms with a lateral displacement, giving in effect a shearing interferogram. Sources of error in several methods of producing and interpreting dupligrams are discussed.
W.T.Welford

535.31

5144 RESULTS OF CENTRING MEASUREMENTS ON OPTICAL SYSTEMS AND THE INFLUENCE OF CENTRING ERRORS ON THE IMAGE QUALITY OF PHOTOGRAPHIC OBJECTIVES. W.Notni.
Optik, Vol. 16, No. 10-11, 659-67 (Oct.-Nov., 1959). In German.

A numerical study was made of principal ray displacements resulting from decentering of components of a triplet objective; the results were verified experimentally on a test lens which could be deliberately decentred. Results of resolution tests on this lens are also given.
W.T.Welford

535.31

5145 USE OF OPTICAL ABERRATION COEFFICIENTS IN OPTICAL DESIGN. F.D.Cruickshank and G.A.Hills.
J. Opt. Soc. Amer., Vol. 50, No. 4, 379-87 (April, 1960).

A general account is given of the way in which the aberration coefficients introduced by Buchdahl (1954) are made use of in the design of optical systems. Experience shows that for many applications the coefficients of third, fifth, and seventh orders provide a new and adequate technique for the analysis of the correction state of a system, the understanding of the raison d'etre of a particular type of system, and the differential correction of a rough design. The geometrical representation and classification of the individual terms of the aberration polynomials is discussed. The method is exemplified by excerpts from the design of a telephoto objective.

535.31

5146 ON THE RATIONAL CHOICE OF RAYS TO BE TRACED THROUGH AN OPTICAL SYSTEM. W.Dannberg.
Optik, Vol. 16, No. 10-11, 616-20 (Oct.-Nov., 1959). In German.

It is shown by a study of the primary and secondary aberration terms that in most cases complete information about them is obtained by tracing enough rays in the meridional and principal sagittal sections with two exceptions: these are secondary coma and a term for which the wave-front aberration is of the form $x^2y^2 + 2y^4$ where x and y are pupil coordinates in the sagittal and meridional sections; to determine these it is necessary to trace skew rays outside the principal sagittal section. An approximate formula for the vignetting factor is suggested.
W.T.Welford

535.8

5147 THEODOLITES. I-II. H.Hoitz.
Arch. tech. Messen, No. 285 (J1112-2) 213-6 (Oct.); No. 286 (J1112-3), 233-6 (Nov., 1959). In German.

A descriptive survey covering design of telescopes, circle bearings, glass divided circles, methods of circle reading which automatically eliminate centring error, spirit levels and self-levelling devices. 14 references.
W.T.Welford

535.8

5148 AN IMAGE-SPLITTING MICROSCOPE FOR ACCURATE MEASUREMENT. J.Dyson.
Nature (London), Vol. 184, 1561 (Nov. 14, 1959).

Describes how, by fitting in the eyepiece a suitable image splitting device, the two images may be sheared across each other until edge-to-edge contact is obtained. By reversing the shear until edge-to-edge contact is again obtained, the diameter of the object may be measured. The technique is illustrated by application to blood corpuscles.
E.G.Knowles

535.8

5149 THE THEORY OF THE DETERMINATION OF DRY WEIGHT OF BIOLOGICAL OBJECTS USING THE INTERFERENCE MICROSCOPE. H.Pehland and H.Hager.
Z. wiss. Mikr., Vol. 64, No. 5, 271-85 (Nov., 1959). In German.

A survey is given of the theory of the determination of dry weight using the interference microscope. Methods are discussed which consider water as the inclusion. Problems are solved by employing more than one wavelength. The determination of the concentration of solid matter is discussed.
S.Tolansky

535.8

5150 RECORDING OPTICAL LEVER. R.V.Jones and J.C.S.Richards.
J. sci. Instrum., Vol. 36, No. 2, 90-4 (Feb., 1959).

A small optical lever is described which can detect a change of 10^{-10} rad in orientation of a 2 mm mirror, with a response time of about 0.25 sec. A differential cadmium selenide photocell is used with a standard optical grid technique to detect the displacement of the reflected light beam from a 4 V, 3.2 W lamp. Transistors are used to stabilize the lamp current and to amplify the signals for a pen recorder. "Noise" arising from convection currents in the light beam and from the photocells appears not to exceed greatly the photon fluctuations in the light beam. Records illustrate the performance of the lever and amplifier in detecting changes in dimension of a crystal of a few times 10^{-10} cm and changes in refractive index of a gas by a few times 10^{-9}. The system has also been applied to an infrared detector using the linear expansion of a metallic strip, where the limit for a 5 × 0.2 mm strip is about 10^{-11} W for a 1 c/s bandwidth. For this purpose the signal can be differentiated with respect to time, and velocities of down to 30 μ/annum can be observed. It appears that a displacement of 10^{-12} cm could be detected.

535.8

5151 THE POSSIBILITIES OF THE INTRODUCTION OF HEAT INSULATING FILTERS AND COOLED MIRRORS IN PROJECTORS. W.Naundorf.
Optik, Vol. 16, No. 10-11, 667-8 (Oct.-Nov., 1959). In German.

In the assessment of a projector the relation between the useful light and the rise in temperature produced in the picture gate by the radiation is important. If it be assumed that the rise is proportional to the amount of energy absorbed by the film at the gate, expressions can be obtained for the total, in the visible spectrum, and useful light fluxes. Values for these quantities relating to a 4800° K light source and to a coloured glass of 1, 3 and 5 mm thickness, an interference filter and a cooled mirror, are listed.
S.Weintroub

535.8

5152 A NEW METHOD FOR MEASURING ABSOLUTE REFLECTION COEFFICIENTS WITH DOUBLE BEAM SPECTROMETERS. A.Vaško.

Czech. J. Phys., Vol. 9, No. 5, 667-8 (1959). In German.

Describes a mirror system, with one extra reflection (the specimen) in the measuring beam, to be added to a transmission instrument; the air paths are equal to compensate for infrared atmospheric absorption. G.F.Lothian

535.8

5153 CHAIN BI-REFRINGENT FILTERS. I.Šolc.

Czech. J. Phys., Vol. 9, No. 2, 237-49 (1959).

Modifications of the Lyot-type filter are described and analysed. Computations are made for quartz, ADP, and calcite filters. Tuning of filters by inclination is described. Ray convergence and its limitation is analysed. The suppression of secondary maxima is described and filters at λ 5000 with transmissions ranging from 50 to 0.5 A are computed. Data are recorded for a 14 plate filter (2 A) used on a solar sphere eruption line. S.Tolansky

535.8 : 545

WAVELENGTH-SCANNING, I.R. ABSORPTIOMETER USING INTERFERENCE FILTERS. See Abstr. 4754

535.8

5154 TWO-LAYER ANTI-REFLEXION COATING FOR LOW REFRACTIVE INDEX GLASS. L.Holland and T.Putner.

J. sci. Instrum., Vol. 36, No. 2, 81-4 (Feb., 1959).

A method is described for producing durable two-layer anti-reflexion coatings on low refractive index (approximately 1.5) glasses. Practical difficulties in evaporating absorption free films of high index materials are avoided by reactively sputtering a bismuth oxide film which is then coated with an evaporated magnesium fluoride film. The initial oxide layer is prepared by sputtering bismuth in oxygen from sector-shaped cathodes placed under a rotary holder, and the magnesium fluoride is evaporated in sequence from a vapour source arranged under the edge of the rotary holder. To reduce the reflectance of a glass (n = 1.5) at a specified wavelength in the visible region, the bismuth oxide is deposited until the glass reflectance has risen to 8% and the magnesium fluoride evaporated until the reflectance falls to a minima ($R < 0.1\%$). Curves are given for the reflectance of the two-layer coating in the visible region. A simple method of monitoring the wavelength of the reflectance minima is described. It is shown that the wear resistance of the two-layer coating is equal to that of a single-layer magnesium fluoride film and is improved by baking at 250° C.

535.8

5155 POLYETHYLENE ANTI-REFLECTION COATING FOR KRS-5. A.Vaško.

Czech. J. Phys., Vol. 9, No. 1, 128-9 (1959)

For the mixed single crystal TlBr + TlI (KRS-5) which transmits well into the 38 μ region and has refractive index ~ 2.40, the high reflection losses can be reduced by using polyethylene as an anti-reflection coating. The refractive index of polythene satisfies the necessary condition and it is free from absorption above λ = 14 μ. It is not affected by humidity. The polyethylene is deposited from solution in CCl_4 and heat treated. S.Tolansky

535.8

5156 OLD AND NEW DESIGNATIONS FOR SCHOTT GLASSES. H.Naumann.

Optik, Vol. 16, No. 12, 743-4 (Dec., 1959). In German.

Two tables of equivalent old and new melt numbers are given, the first in serial order of new numbers and the second in serial order of the old. W.T.Welford

535.6

5157 ON THE DISTRIBUTION IN CUTTING A SPHERE INTO TRANSPARENT SECTIONS OF FINITE THICKNESS. G.Bach.

Z. wiss. Mikr., Vol. 64, No. 5, 265-70 (Nov., 1959). In German.

A mathematical analysis is given for the sectioning of a transparent sphere and the problem is solved for applications in histology, especially in connection with the embedding of spherical particles into transparent material for sectioning. S.Tolansky

535.8 : 545

AUTOMATIC SCANNER FOR ELECTROPHORESIS AND CHROMATOGRAPHY PAPER STRIPS. See Abstr. 4759

535.8 : 621.327

5158 SIMPLE LIGHT SOURCE OF ABOUT 10 mμsec DURATION. G.Porter and E.R.Wooding.

J. sci. Instrum., Vol. 36, No. 3, 147 (March, 1959).

A coaxial design enables sparks of 11 to 13 mμs duration to be obtained. The peak intensity is of the order of 1 W and the spectral range is greater than 1900 to 6000 A. E.R.Wooding

535.33

5159 SPECTRUM DISPLAY COMPARATOR. W.J.Price.

Brit. J. appl. Phys., Vol. 10, No. 8, 352-5 (Aug., 1959).

This instrument for evaluation in photographic spectroscopy is a projection-comparator provided with means for displaying a density profile of part of the spectrum. The design allows the projected spectrum images to remain stationary for examination while the density profile is displayed simultaneously on a cathode-ray tube. Applications to both qualitative and quantitative spectrography are outlined.

535.33

5160 THE SHAPE OF SPECTRAL LINES; TABLES OF THE VOIGT PROFILE $\frac{a}{\pi}\int_{-\infty}^{\infty} \frac{e^{-y^2}\,dy}{a^2 + (v-y)^2}$. D.W.Posener.

Austral. J. Phys., Vol. 12, No. 2, 184-96 (June, 1959).

A brief discussion is given of some methods of computing the line shape resulting when a spectral line is broadened simultaneously by Gaussian and Lorentz effects, and tables and curves are presented for representative values of the variables.

535.33

5161 A RECORDING RAMAN SPECTROGRAPH. P.O.Kinell.

Ark. Kemi, Vol. 14, Paper 32, 337-51 (1959).

The instrument uses a helical mercury discharge lamp for exciting the spectra and a Hilger E612 glass prism spectrograph as the dispersive element. It can also be used photographically. The direct recording is achieved by a system consisting of a multiplier photo-tube (1P21) as the detecting device, an amplifier tuned to 100 c/s, a homodyne rectifier, a cathode follower and a pen recorder. The wave-number determinations are made on the plates by using Hartmann's formula and on the recordings from the wave-number scale in the instrument. In both cases an accuracy of about ± 1 cm^{-1} is obtained. The figure of merit of the spectrograph is discussed as well as the resolution which can be obtained in practical work. The technique employing polaroid cylinders around the Raman tube for depolarization measurements is discussed.

535.33

5162 A NEW DIRECT READING MIRROR MONOCHROMATOR FOR ULTRAVIOLET AND VISIBLE SPECTRAL LINES. H.G.Krüger.

Z. InstrumKde, Vol. 67, No. 11, 276-81 (Nov., 1959). In German.

Description of a new mirror-monochromator with two interchangeable prisms for the spectral regions 205-440 mμ and 390-1100 mμ.

535.33

5163 RESOLUTION OF WIDE-RANGE GRATING SPECTROMETERS. A.E.Martin.

Nature (London) Vol. 184, 975-6 (Sept. 26, 1959).

By considering the sensitivity of a given detector the author shows that the wave-number resolution is constant over a wide range of wavelengths (2 - 125μ). E.G.Knowles

535.33

5164 A STUDY OF THE IMAGE OF A PLANE-GRATING EBERT SPECTROGRAPH. H.Kaiser, K.D.Mielenz and F.Rosendahl.

Z. InstrumKde, Vol. 67, No. 11, 269-73 (Nov., 1959). In German.

The Ebert spectrograph consisted of a large spherical mirror with the slit mounted underneath the optical axis. The spectral lines showed a slightly rhombic character as well as being smeared by the coma in the extremities of the spectral region. These phenomena were investigated in detail.

535.33

5165 USE OF THE WEIZAC IN THEORETICAL SPECTROSCOPY. G.Racah.
Bull. Res. Coun. Israel, Vol. 8F, No. 1, 1-14 (Sept., 1959).

Electronic computer programs for theoretical calculations in atomic spectroscopy are described, with special reference to the Weizmann Institute of Science machine.

535.33

5166 DOUBLE-BEAM INFRA-RED GRATING SPECTROMETER. J.L.Hales.
J. sci. Instrum., Vol. 36, No. 6, 264-6 (June, 1959).

An i.r. foreprism-grating spectrometer of compact design is described. Non-precision components are used in the instrument which nevertheless has a high performance. Two 2400 lines/in. gratings are used in the first order to cover the wavelength range 2 to 17 μ. A ratio-recording double-beam system is employed.

535.33

5167 METHOD OF DOUBLE-BEAM SPECTROPHOTOMETRY IN THE VACUUM ULTRA-VIOLET. J F.James.
J. sci. Instrum., Vol. 36, No. 4, 188-90 (April, 1959).

Absorption coefficients in the far vacuum ultraviolet are measured, using an unsteady radiation source. The beam emerging from a monochromator is divided, and one part if passed through an absorber cell. Two photomultipliers and a bridge network are used to measure the intensity ratio with and without an absorber in the cell. Absorption coefficients can be measured with an accuracy of 1% or better at wavelengths down to 800 A.

535.33 : 539.18

5168 CORRECTION FOR SYSTEMATIC WAVELENGTH SHIFTS IN ATOMIC BEAM DEVICES.
R.L.Barger and K.G.Kessler.
J. Opt. Soc. Amer., Vol. 50, No. 4, 352-6 (April, 1960).

Light emitted or absorbed by atoms in an atomic beam is shifted in frequency relative to the frequency for a stationary atom if the light ray is not normal to the trajectory of the atom. The magnitude of this shift is calculated and several devices which correct for this effect are described. For photoelectric recording of interference fringes, complete compensation can be achieved. In the case of photographic recording, it is shown that the residual error is negligible.

535.33

5169 THEORY OF OPERATION AND CONSTRUCTIONAL PRINCIPLES OF A HIGH-PRECISION SPECTROSCOPIC SPARK SOURCE. Á.Bardócz.
Brit. J. appl. Phys., Vol. 10, No. 7, 310-14 (July, 1959).

For the production of time resolved spark spectra, an electronically controlled source operating with a high precision in time is necessary. The high operational precision of the spark source with double controlling spark gaps is, on the one hand due to the spark gaps being electrically prestressed, and on the other hand to the transient wave arising at the breakdown of spark gaps. A further condition for the high operational precision in time is the adequate preionization of the spark gaps. A spark frequency higher than mains frequency may be realized by using a saturated iron-cored transformer to give complete separation of the charging and discharging processes. To illustrate time-resolved spectrochemical analysis, the separation of the background of the spark spectrum was carried out by means of a rotating disk placed before the slit of the spectrograph. Owing to the separation of the background the working curve obtained is a straight line even in the case of small percentage contents, and the sensitivity may be increased.

PHYSICAL OPTICS

(Luminescence is included under Solid-State Physics, Liquid State, or Gaseous State)

535.39

5170 ON THE POSSIBILITY OF DETERMINING THE OPTICAL CONSTANTS AND THICKNESSES OF VERY THIN METAL FILMS USING MEASUREMENTS AT NORMAL INCIDENCE. C.Schwink and H.Pohland.
Z. Phys., Vol. 158, No. 1, 12-25 (1960). In German.

A theoretical examination of the deductions possible from a knowledge of the complex amplitudes transmitted and reflected from either side. If the thickness d is assumed to be small with respect to the wavelength, the equations expanded in powers of d and the first terms only taken, then a complete solution is impossible; by taking into account higher powers, d and the optical constants n and k can be calculated, but for small d the equations are ill-conditioned; in general only the product nkd can be calculated with good precision when d is small. It is shown also that Schopper's three-line method (Abstr. 1672 of 1952) is invalid since the method involves taking only the first terms in the above expansion. If d is known then n and k can be calculated. W.T.Welford

535.39

5171 THEORETICAL STUDY OF THE INFLUENCE OF INTERIOR REFLECTIONS ON THE PATH OF A LIGHT RAY PASSING THROUGH A THIN TRANSPARENT PLATE SUBJECT TO FORCES IN ITS MEAN PLANE. H.Favre.
Ingen.-Arch., Vol. 28, 39-52 (1959). In French.

Theoretical calculations are made on the effects of multiple reflections in a thin plate subject to stresses. Calculations are made of the variation of the path and the variation of intensities in the emerging ray which are produced by the application of forces on the plate. The errors created by the multiple reflections are computed in the cases where determination is made of the tension in the plate and computation made of the birefringence. It is shown how the interior tensions can be derived with the help of an interfero-photometric method. The only case considered here is that in which the beams traverse the plate orthogonally. S.Tolansky

535.4

5172 THE OPTICAL PROPERTIES OF INTERFERENCE FILTERS MEASURED IN A SPECTRAL RANGE OF FINITE WIDTH. G.Koppelmann and K.Krebs.
Z. Phys., Vol. 157, No. 5, 592-600 (1960).

A computational method is described whereby the wavelength transmission of a dielectric multilayer interference filter is obtained in the form of a straight line. Data are given for a seven layer ZnS–cryolite filter. The measurements are made with a narrow slit monochromator and multilayer. A very accurate determination of the halfwidth and localization of maximum transmission is possible by this method. The method succeeds in eliminating errors which normally arise due to the finite width of the spectral range used in the spectrophotometric measurements. Transmission curves are illustrated as a function of the monochromator slit width. The technique described is particularly suitable for interference filters having a very small spectral range. S.Tolansky

535.41

5173 DOUBLE-PASSED TWO-BEAM INTERFEROMETERS. P.Hariharan and D.Sen.
J. Opt. Soc. Amer., Vol. 50, No. 4, 357-61 (April, 1960).

When the rays emerging from a conventional two-beam interferometer are reflected back through the instrument, fringes similar in appearance and behaviour to three-beam fringes are obtained. Extremely accurate measurements are possible with the help of these fringes, using a photometric setting criterion. The mode of formation of these fringes, as well as the theoretical intensity distribution in them under various conditions, are discussed.

535.41

5174 THREE-BEAM INTERFEROMETER. P.Hariharan and D.Sen.
J. sci. Instrum., Vol. 36, No. 2, 70-2 (Feb., 1959).

The instrument utilizes a beam dividing system similar to that used in the Jamin interferometer, but employs three interfering beams instead of two. This permits the determination of the fractional fringe order with an extremely high degree of accuracy. It can be used for studying very small changes of refractive index in gases and liquids, and, in a slightly modified form, as an autocollimating interferometer for the precise measurement of the thickness of evaporated films.

535.41

5175 PHOTOELECTRIC SETTING METHODS FOR A THREE-BEAM INTERFEROMETER.
P.Hariharan, D.Sen and M.S.Bhalla.
J. sci. Instrum., Vol. 36, No. 2, 72-5 (Feb., 1959).

Some of the photoelectric methods which can be applied to

estimate the fractional fringe order in the three-beam interferometer described in the preceding abstract are outlined, and their comparative merits are discussed. Experimental measurements show that with the help of such methods settings can be repeated to better than $\lambda/1000$, provided care is taken to minimize temperature fluctuations.

535.41

5176 MULTI-BEAM INTERFERENCE IN CONVERGENT LIGHT. G.Koppelmann and K.Krebs.
Z. Phys., Vol. 158, No. 2, 172-80 (1960). In German.

Formulae describing the sharpness and luminosity of fringes produced by convergent rays are deduced and tested experimentally by means of measurements on interference filters. The application of these formulae to two problems is discussed: the permissible deviation from collimation when Fizeau fringes are being used (Tolansky); and the diameter of the output diaphragm behind a Fabry–Perot interferometer adapted for direct recording.

535.41 : 531.74

5177 DETERMINATION OF PARALLELISM OF WORK PIECES UP TO SEVERAL METRES IN LENGTH WITH THE HELP OF OPTICAL INTERFERENCE. M.Dühmke.
Optik, Vol. 16, No. 10-11, 646-9 (Oct.-Nov., 1959). In German.

Industrial comparators can be used only up to 20 cm. With a Köster's double prism a 4 metre length can be examined and adjusted for parallelism. A Michelson interferometer system is also described for the purpose. It is useful for matching the parallelism of the ends of an end standard of several metres in length.

S.Tolansky

535.41

5178 INTERFEROMETRIC MEASUREMENT OF SMALL ANGULAR DISPLACEMENTS. P.Hariharan and D.Sen.
Brit. J. appl. Phys., Vol. 10, No. 10, 445-52 (Oct., 1959).

A modified three-beam interferometer is described. The instrument is extremely sensitive to angular displacements in a specified plane and is capable of a high degree of accuracy. In addition it is easy to handle and quite stable, since it is relatively insensitive to angular displacements in any other plane and is also completely unaffected by a linear translation of the detecting element.

535.41 : 531.71

A PARALLEL TESTING INTERFEROMETER FOR SLIP GAUGES UP TO FOUR METRES LONG. See Abstr. 4981

535.41 : 534.2

THE MAKING VISIBLE OF NODES AND THE MEASUREMENT OF THE AMPLITUDES ON VIBRATING METAL PLATES USING AN INTERFERENCE MICROSCOPE. See Abstr. 5069

535.42

5179 DEVIATION OF ZONE LENSES PRODUCED BY POLARIZATION. J.R.Meyer-Arendt.
Nature (London), Vol. 184, 811 (Sept. 12, 1959).

Zone lenses were made by photographing the interference patterns of birefringent crystals in convergent light. Deviations from the desired law of increase of zone radii were found.

W.T.Welford

535.42 : 534.21

5180 THE DIFFRACTION OF LIGHT BY ULTRASONIC WAVES. P.Phariseau.
Simon Stevin, Vol. 33, No. 2, 72-8 (June, 1959).

By solving the equations of wave motion in two dimensions, known results for diffraction at oblique incidence by a progressive ultrasonic wave are obtained, including the intensities of the different spectra.

W.T.Welford

535.42 : 534.21

5181 DEVELOPMENT OF A VARIABLE PHASE STROBOSCOPE WITH LIGHT MODULATION BY ULTRASONIC WAVES. N.Segard, J.Pouliquen and B.Trentesaux.
Ann. Soc. Sci. Bruxelles I, Vol. 73, No. 3, 373-82 (1959). In French.

Collimated light from a slit is diffracted by plane stationary ultrasonic waves of frequency f in a liquid cell. The intensity in the central maximum in the diffraction pattern varies at frequency 2f because the stationary wave pattern oscillates between maximum and zero intensity with this frequency. This central maximum is isolated and used as a secondary stroboscopic source with controlled phase. The apparatus was applied to the study of stationary and nearly stationary ultrasonic wave patterns.

W.T.Welford

535.43

5182 THEORETICAL INVESTIGATIONS ON THE LIGHT SCATTERING OF COLLOIDAL SPHERES. VIII. ANGULAR LOCATION OF INTENSITY MAXIMA AND MINIMA IN THE RADIATION DIAGRAM OF COLLOIDAL SPHERES.
M.Nakagaki and W.Heller.
J. chem. Phys., Vol. 32, No. 3, 835-42 (March, 1960).

For Pt VII, see Abstr. 2255 (1960). The angular position of scattering maxima and minma in the radiation diagram of non-absorbing colloidal spheres is calculated for $(m-1) \to 0$ and for $m = 1.20$, by using in the former case the Rayleigh–Gans approximation and in the latter case the exact Mie scattering functions. By means of empirical equations based upon the discrepancies between the Rayleigh–Gans data and the Mie data, the approximate location of scattering maxima and minima is calculated also for the m values 1.05, 1.10, 1.15, 1.25, and 1.30. The expected precision and accuracy of particle size determinations from the angular location of scattering maxima and minima is discussed and the minimum angular ranges to be covered in a given instance are defined. A few pertinent features of the related La Mer method (HOTS) are briefly discussed.

535.43

5183 LIGHT SCATTERING BY SPHERICAL METAL PARTICLES. R.H.Giese.
Z. Naturforsch., Vol. 14a, No. 12, 1085-8 (Dec., 1959). In German.

A programme for the Siemens digital computor 2002 has been prepared for computing the Mie coefficients for complex refractive indices. Up to 24 terms in the series for the coefficients can be used, corresponding to a precision of 3 or 4 significant figures in the results with a size parameter $\alpha \leq 16$. As examples results for $\alpha = 10$ and a range of complex indices are given.

W.T.Welford

535.5

5184 A SIMPLE PHOTOELECTRIC COMPENSATING POLARIMETER USING MAGNETIC ROTATION.
W.Hellenthal.
Z. InstrumKde, Vol. 68, No. 1, 16-17 (Jan., 1960). In German.

535.5

5185 CONICAL ANALYSER.
M.Katalinić.
Annu. Fac. Phil. Skopje, Sect. Sci. Nat., Vol. 10, 45-59 (1959). In Serbo-Croat.

Describes the properties and various uses of the conical analyser whose invention is variously attributed to Mach [see Born, Optik, 35-6 (1933)], and to Umow (Abstr. 1641 of 1900); the conical analyser used by the author was made from neutral black glass and had the angle of aperture 65.5°.

F.Lachman

535.5

5186 PHOTOELECTRIC DETERMINATION OF THE POSITION OF THE NEUTRAL LINES OF A WEAKLY BIREFRINGENT MEDIUM. H.Wayland and J.Badoz.
C.R. Acad. Sci. (Paris), Vol. 250, No. 5, 888-90 (Jan. 25, 1960). In French.

Discusses some considerations that arise in the use of photoelectric determinations of extinction direction by methods analogous to the visual method described by Jerrard (Abstr. 2816 of 1956). In the visual method linearly polarized light passes in turn through the birefringent medium, a quarter-wave plate, a half-shadow device and enters an analyser. In the photoelectric methods the half-shade is replaced by a Faraday cell which can modulate the light beam and the arrangements with and without the quarter-wave plate is discussed. The limitations imposed by noise are considered and the photoelectric methods compared with the visual method.

H.G.Jerrard

535.55 : 539.214

5187 PHOTOELASTIC EFFECT IN POLYMETHYL METHACRYLATE, POLYBUTYL METHACRYLATE AND POLYVINYL ACETATE.
N.M.Bazhenov, M.I.Bykov, L.A.Volkova and M.V.Vol'kenshtein.
Fiz. tverdogo Tela, Vol. 1, No. 8, 1179-87 (Aug., 1959). In Russian.

The effect was studied at constant true strain in polymethyl methacrylate (PMMA), polybutyl methacrylate (PBMA) and polyvinyl acetate (PVA). The dependence of birefringence on temperature was investigated. The anomalous hysteresis detected in PMMA was explained by two relaxation mechanisms with widely differing relaxation periods, related to the structure of the PMMA chain. The PMMA specimen with a higher temperature of vitrification is

characterized by the birefringence/temperature curve being shifted towards higher temperatures. The absence of hysteresis in PBMA and PVA was explained. F.Lachman

COLORIMETRY . PHOTOGRAPHY

77 : 539.1.07

5188 THE EFFECT OF DEVELOPMENT ON THE STRUCTURE OF TRACKS AND THE FOG IN FINE-GRAIN EMULSIONS. I.Ahmad and J.Demers.
Canad. J. Phys., Vol. 37, No. 12, 1548-52 (Dec., 1959). In French.

The developing process of fine grain emulsion is studied as a function of the duration of the development. It is shown that exposed grains are affected almost at once with simultaneous grain growth. The variation of the opacity appears to be so rapid that the visibility of the grains increases greatly without however a parallel increase in the grain size. It is concluded that prolonged development merely raises the fog level without influencing the grain size. S.J.St-Lorant

77

5189 INVESTIGATION OF THE WAVELENGTH DEPENDENCE OF THE Λ-TRANSFORMATION.
H.J.Hübner and H.Ohzu.
Z. angew. Phys., Vol. 11, No. 12, 460-3 (Dec., 1959). In German.

Candler (Spectrochimica Acta Vol. 8, 262 (1956) has found for a number of photographic plates that the slope of a plot of Λ against log E, where E is exposure and Λ is a function of plate transmission is independent of wavelength (λ). The present authors do not confirm this using λ = 265-365 mμ, and plates Ilford Q1 and Perutz "Spektral-Blau 450". G.F.Lothian

77

5190 SENSITOMETRIC MEASUREMENTS WITH DOUBLE EXPOSURE (USING EQUI-DENSITY LINES). E.Lau.
Optik, Vol. 16, No. 11-12, 623-8 (Oct.-Nov., 1959). In German.

The effect of double exposure on a photographic plate has been examined by making two exposures in succession to (a) a set of interference fringes and (b) a slit source, the plate being turned through 90° between exposures. Study of the resulting negatives by equi-densitometry shows that one exposure affects the other whatever the conditions as regards relative length of the exposures, or the time interval between them. J.W.T.Walsh

77 : 541.18

5191 APPLICATION OF EQUI-DENSITOMETRY TO THE QUANTITATIVE EXAMINATION OF SMOKE-PLUME PHOTOGRAPHS. H.Rauch.
Optik, Vol. 16, No. 11-12, 629-32 (Oct.-Nov., 1959). In German.

The photograph of a smoke plume can be combined with a raster of neutral density wedges to give families of equi-density curves. The manufacture of the raster is described and by using the Sabattier effect, equi-density curves for various degrees of blackening can be obtained. J.W.T.Walsh

HEAT . RADIATION

536.2

5192 DIFFUSION IN BRANCHING REGIONS. J.C.Jaeger.
Proc. Cambridge Phil. Soc., Vol. 56, Pt 1, 55-63 (Jan., 1960).

The problem of diffusion from an instantaneous point source in a thin plane sheet which is intersected by one or more other thin plane sheets of the same material is considered. This problem arises in the study of the diffusion of packets of transmitter substance in synaptic clefts, and some numerical results for the amphibian neuro-muscular junction are presented. A similar discussion applies to branching rods and to cases where there is loss of diffusing substance at the surfaces of the sheets.

536.2

5193 THE HEAT CONDUCTION EQUATION FOR THERMAL GRADIENTS. K.Zoller.
Ingen.-Arch., Vol. 28, 366-72 (1959). In German.

It is shown that the Fourier heat equation, considered as an expression of the first law of thermodynamics, is not completely applicable in the case of non-stationary thermal gradients. S.Weintroub

536.2

5194 ON TWO FORMS OF THE SOLUTION OF THE EQUATION OF HEAT CONDUCTION. P.Vernotte.
C.R. Acad. Sci. (Paris), Vol. 249, No. 21, 2168-9 (Nov. 23, 1959). In French.

The well-known transformation of the theta function is obtained by using the physical fact that two different solutions of the heat conduction equation have a common region of validity. (This approach is by no means new, and is thoroughly discussed in Mathematical Physics by H.Jeffreys and B.Jeffreys, Cambridge, 1956). From the result, the author concludes tentatively that it may, in certain cases, be safe to replace the series occurring in certain types of heat conduction problem by the corresponding integrals. H.N.V.Temperley

536.2

5195 A NON-LINEAR PROBLEM IN THE DETERMINATION OF THE TEMPERATURE IN AN ELECTRICALLY HEATED PLATE. R.Gerber.
C.R. Acad. Sci. (Paris), Vol. 247, No. 8, 708-9 (Aug. 25, 1958). In French.

536.2

5196 A PROBLEM WITH LIMITS PRESENTED BY THE DETERMINATION OF THE TEMPERATURE IN AN ELECTRICALLY HEATED BODY. R.Gerber.
C.R. Acad. Sci. (Paris), Vol. 249, No. 18, 1747-9 (Nov. 2, 1959). In French.

The problem in the preceding abstract is modified so that the thermal exchanges take place along the face in contact with the isothermal flow. A mathematical treatment is given which permits an approximate solution to be obtained. S.Weintroub

536.2 : 621.315.23

5197 TRANSIENT TEMPERATURE RISE DUE TO A LINE SOURCE IN A SEMI-INFINITE MEDIUM, WITH A RADIATION BOUNDARY CONDITION AT THE INTERFACE. H.Goldenberg.
Brit. J. appl. Phys., Vol. 10, No. 7, 314-17 (July, 1959).

An approximate formula and an error bound are given for the deviation between this solution and the solution subject to an isothermal boundary condition at the interface. A condition is given for the validity of Neher's approximate formula [Abstr. 2387 B of 1949. Elect. Engng, N.Y., Vol. 67, 412 (May, 1949)] for the steady-state temperature. In a typical example it is shown that the temperature rise above ambient at the surface of a buried cable differs negligibly when the two types of boundary condition are assumed valid at the earth's surface.

536.2 : 533.7

HEAT TRANSFER FROM PLANE SURFACE TO FLOWING GAS. See Abstr. 5053.

536.2 : 534.39

5198 EFFECT OF SOUND WAVES ON HEAT TRANSFER. P.J.Westervelt.
J. Acoust. Soc. Amer., Vol. 32, No. 3, 337-8 (March, 1960).

The suggestion is put forward that the effect of sound waves on heat transfer is dominantly a result of the modification of the inner streaming boundary layer which is known to occur when the sound particle displacement amplitude s exceeds in magnitude the acoustic boundary layer thickness δ_{ac}.

536.2 : 534.39

5199 ON THE EFFECTS OF SOUND WAVES ON HEAT TRANSFER. J.P.Holman.

J. Acoust. Soc. Amer., Vol. 32, No. 3, 407-8 (March, 1960).

A discussion is presented of the physical mechanism as proposed by Westervelt (preceding abstract) whereby heat transfer rates may be increased in the presence of intense sound fields.

536.2

5200 THERMAL INITIATION OF EXPLOSIVES. J.Zinn and C.L.Mader.

J. appl. Phys., Vol. 31, No. 2, 323-8 (Feb., 1960).

Numerical solutions were obtained for the nonlinear heat conduction equations arising in the theory of thermal explosions. Explosion times are calculated for externally heated spheres, cylinders, and slabs of several explosive materials, and the results are shown to agree with experiment.

536.2

5201 AN EXPERIMENTAL STUDY OF HEAT TRANSFER TO NITROGEN–OIL MIXTURES.

R.F.Knott, R.N.Anderson, A.Acrivos and E.E.Petersen.

Industr. engng Chem., Vol. 51, No. 11, 1369-72 (Nov., 1959).

Describes briefly the apparatus and gives the results of experiments on the heat transfer to nitrogen–oil mixtures in a vertical transfer tube. The results confirm an increase in the transfer coefficient on the injection of gas, but wide variation from results of other workers emphasises the need for further work.

E.G.Knowles

536.2

5202 THE USE OF COMPLETE TEMPERATURE–TIME CURVES FOR DETERMINATION OF THERMAL CONDUCTIVITY WITH PARTICULAR REFERENCE TO ROCKS.

J.C.Jaeger.

Austral. J. Phys., Vol. 12, No. 3, 203-17 (Sept., 1959).

Most of the transient methods at present in use for the determination of thermal conductivity involve the study of the asymptote of a temperature–time curve. This implies that they require relatively long times of experiment and make no use of the information contained in measurements of temperature at smaller times. A simple method of reducing observations is described which uses measurements of temperature at equally spaced intervals of time, together with a curve calculated from the theory. Such curves are given for a number of experimental situations likely to be useful for the measurement of the thermal conductivities of rocks. Among these are the line source: (1) in the semi-infinite solid, (2) along the axis of a cylinder, (3) along the surface of a cylinder. These methods yield values for both the thermal conductivity and diffusivity, and the desirability of such measurements is stressed. The application of the method to the thermal conductivity probe and to the measurement of the diffusivity of solids in the form of slabs and cylinders is also discussed. An alternative method of the same type, using the times at which specified temperatures are attained, is also described.

536.2

5203 ON THE CYLINDRICAL PROBE METHOD OF MEASURING THERMAL CONDUCTIVITY WITH SPECIAL REFERENCE TO SOILS. II. ANALYSIS OF MOISTURE EFFECTS. D.A.de Vries and A.J.Peck.

Austral. J. Phys., Vol. 11, No. 3, 409-23 (Sept., 1958).

For Pt I, see Abstr. 7857 (1958). Thermal conductivity measurements in unsaturated moist porous media are complicated by the action of gravity on the moisture and by moisture movement caused by temperature gradients. The effects of these factors are discussed for the cylindrical probe method. A theoretical analysis shows that temperature gradients give rise to a decrease of moisture content in the vicinity of the probe and a (much smaller) increase at greater radial distances from the probe axis. It is shown how these moisture changes depend on the physical properties of the medium, the probe radius, and the time of heating. The magnitude of the decrease of moisture content at the probe surface is approximately inversely proportional to the probe radius; it increases with increasing time and temperature. In the present experiments the region of reduced moisture content has a thickness of the order of the probe radius (0.05 cm). The absolute change in moisture content and the influence on the measured value of the conductivity are small at temperatures below about 40°C. Gravity causes a decrease of moisture content with height in a manner determined by the relation between moisture content and water pressure. In probe experiments the effect of this variation of moisture content in the vertical direction is negligible at water pressures below about −100 cm (using atmospheric pressure as a datum). Some experimental results are presented and analysed. The importance of the cooling branch in detecting the influence of moisture movement is illustrated.

536.21

5204 THIN-HEATER THERMAL CONDUCTIVITY APPARATUS. N.E.Hager, Jr.

Rev. sci. Instrum., Vol. 31, No. 2, 177-85 (Feb., 1960).

For measuring the thermal conductivity of insulating materials. A constant current is passed through a rectangular sheet of stainless steel foil so that the rate of generation of heat per unit area can be computed from electrical measurements. Identical sample slabs are placed against opposite sides of the heater, and the combination is enclosed in a plastic film and immersed in a bath having constant and uniform temperature. When thermal equilibrium is reached, the temperature drops across the central portions of the sample slabs are measured with differential thermocouples. The elementary one-dimensional form of the Fourier heat transfer equation is used to compute the thermal conductivity from the observed quantities. In preliminary tests with representative insulating materials equilibrium is reached within 15 min. It is estimated that the apparatus is capable of giving measurements accurate to within 2%, and experimental results are not inconsistent with this estimate. Thermal conductivity values are reported for polystyrene and a cork–rubber composition at mean temperatures ranging from liquid nitrogen temperature up to room temperature. Differential thermocouple techniques are discussed. The characteristics of the apparatus make it especially suitable for academic laboratory instruction and for low-temperature measurement.

536.22

5205 THE HEAT TRANSFER BETWEEN COAXIAL CYLINDERS IN LIQUIDS AND GASES.

H.Senftleben and P.Schnabel.

Z. angew. Phys., Vol. 11, No. 11, 428-32 (Nov., 1959). In German.

The expressions and method used in previous papers (Abstr. 399 of 1954) are extended to the problem of heat transfer by natural convection between coaxial (horizontal and vertical) cylinders. The theoretical results expressed in terms of Nu, Gr and Pr, and the dimensions of the cylinders are shown graphically together with experimental values obtained for various fluids. For the horizontal case the theoretical and experimental values agree well, but for the vertical case the experimental values are too few to say other than that they are of the correct order of magnitude. S.Weintroub

536.22 : 532.7

5206 THE THERMAL CONDUCTIVITY OF MONATOMIC DIELECTRIC LIQUIDS. R.Eisenschitz and A.R.Boot.

Proc. Phys. Soc., Vol. 74, Pt 2, 208-16 (Aug., 1959).

In thermal equilibrium the relative coordinates of a pair of molecules are statistically independent of the coordinates of their centre of mass. This independence persists in viscous flow and was supposed to persist in presence of a gradient of temperature. This assumption leads, however, to difficulties if the heat flow is to be expressed in terms of molecular interaction. A new distribution function for molecular doublets is deduced which is appropriate to non-uniform temperature and involves the coordinates of the centre of mass and the relative coordinates. This distribution function is superior to those put forward previously as it takes account of the uniformity of pressure and the vanishing of flow in a steady gradient of temperature. By means of this distribution function an expression for the coefficient of thermal conductivity is obtained which differs from similar expressions as put forward by previous authors.

536.25

5207 EXPERIMENTAL DETERMINATION OF THE INFLUENCE OF THE ECCENTRICITY OF AN ANNULAR SPACE ON THE LOCAL COEFFICIENT OF CONVECTION.

C.Bory and J.Fauré.

C. R. Acad. Sci. (Paris), Vol. 249, No. 17, 1617-19 (Oct. 28, 1959). In French.

The apparatus consisted of two cylinders of radii R_1 and R_2 and 50 cm long, one inside the other, with parallel axes but d apart. The inner cylinder of thin austenitic steel of diameter either 9 or 15 mm was heated electrically to a temperature T of about 800°C. The outer cylinder of 50 mm diameter was of transparent silica. A current of air at temperature T_a was forced through the annular space at speeds between 20 and 40 m/sec. The temperature T_a was measured optically and Q_c the amount of heat lost by convection per unit area of surface at T was deduced from the Joule heating and the radiation loss measured separately. The variation of $\alpha = Q_c/(T-T_a)$

along the inner tube for various eccentricities $e = d/(R_2-R_1)$ was obtained and the results shown graphically are discussed.

S.Weintroub

536.25 : 532.5 : 551.5

5208 NOTE CONCERNING THE INFLUENCE OF ROTATION ON CONVECTION. V.P.Starr.

Tellus, Vol. 11, No. 3, 360-3 (Aug., 1959).

A simplified model, consisting of a layer of an ideal fluid beneath a layer of a second fluid of greater density, is considered from the point of view of stability. The Coriolis parameter is taken as constant, and the conservation of vorticity, mass and energy are assumed. It is then shown that there is an upper limit to the wave length of any finite sinusoidal disturbance which can exist at the boundary between the two fluids. The implications of this finding, and further problems raised by it, are discussed.

R.F.S.Hearmon

536.27

5209 ON THE ASYMPTOTIC BEHAVIOUR OF SOLUTIONS OF HEAT EXCHANGE PROBLEMS.

M.M.Nazarchuk and N.I.Pol'skii.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 4, 759-61 (Dec. 1, 1959). In Russian.

An isolated vessel is filled with a given liquid or gaseous heat carrier into which is introduced a mixture of sufficiently small particles which can be divided into several groups, each characterised by some mass, specific heat conductivity and a coefficient of surface heat transfer. The temperature of this mixture is the same for all groups but is lower than the temperature of the carrier. Then finally, the temperature of the group which heats up most slowly will approach the carrier temperature asymptotically from below, while that of all the other groups will approach it from above.

J.K.Skwirzynski

536.41

5210 MEASUREMENT OF THE THERMAL EXPANSION OF GASES. EQUATION OF STATE OF GASES.

J.Otto and W.Thomas.

Arch. tech. Messen, No. 280, (Ref. V 9221-2) 95-8 (May, 1959). In German.

The calculation of the expansion coefficient from pvT values and the experimental methods, both direct and indirect, for the determination of the coefficient, are briefly reviewed.

S.Weintroub

536.41 : 539.2

THERMAL EXPANSION OF TWO-DIMENSIONAL LATTICES. See Abstr. 4271

536.42

5211 HEAT AND MASS TRANSFER ON THE SURFACES OF COLD LIQUIDS. R.Landsberg.

Bull. Res. Coun. Israel, Vol. 7C, No. 2, 113-14 (Dec., 1959).

The condensation of moisture from the atmosphere on the surface of open chilled water or brine tanks is considered. Results of an approximate calculation are shown graphically for the heat and mass transfer from air at 60% relative humidity to freezing water at 0°C.

S.Weintroub

536.42

5212 THE PRODUCTION OF ICE CRYSTALS BY LARGE ADIABATIC EXPANSIONS OF WATER VAPOUR.

J.Maybank and B.J.Mason.

Proc. Phys. Soc., Vol. 74, Pt 1, 11-16 (July 1, 1959).

The numbers of ice crystals produced by the explosive expansion of a small volume of moist air have been determined for various values of the terminal temperature and supersaturation. Crystals, formed by spontaneous condensation followed by homogeneous crystallization, in clean air, appeared only when the supersaturation exceeded 400% and the terminal temperature fell below -40°C. Thereafter, the crystal concentration continuously increased up to a maximum of $4\times10^6/cm^3$ and not to about $10^{11}/cm^3$ as reported by Schaefer (1954). The appearance of crystals at temperatures above -40°C in room air may be attributed to the presence of ice nuclei. No evidence was obtained for a sudden increase in the crystal production or a change in their mode of formation at about -65°C as suggested by expansion chamber experiments of other workers.

536.42

5213 THEORETICAL RESEARCHES ON THE MELTING POINT OF SMALL SPHERES. A CONTRIBUTION TO THE THERMODYNAMICS OF SURFACE PHASES. K.J.Hanszen.

Z. Phys., Vol. 157, No. 5, 523-53 (1960). In German.

This paper is concerned with the kinetics and thermodynamics of phase change. Starting from the Gibbs theory of surface phases, a derivation is given of the equilibrium and stability conditions for small metal spheres in the presence of metal vapour and insoluble foreign gas. The theory is applicable to spheres of radius not smaller than about 100 A. The main role of the foreign gas is to modify the surface tension by the formation of a surface film. The equations obtained are then used to discuss in detail the problems of co-existence and stability of liquid and solid spheres of the same size. It is found convenient to define the "melting point" as that temperature at which such spheres can co-exist. In terms of this definition, the classical form of Gibbs' Phase Rule breaks down. Some consideration is also given to the possible formation of liquid droplets with solid inclusions.

R.O.Davies

536.42

5214 ON THE MECHANISM OF THE EXPLOSIVE VAPORIZATION OF COPPER WIRE IN VERY INTENSE IMPULSIVE DISCHARGES AND THE BEHAVIOUR OF COPPER AT THE RESULTING HIGH PRESSURES AND TEMPERATURES.

M.Keilhacker.

Z. angew. Phys., Vol. 12, No. 2, 49-59 (Feb., 1960). In German.

A detailed study of exploding wire discharges using copper conductors. A discharge capacitor of 1.3 μF (25-55 kV) giving 35 kA current was used. Temperatures ranged up to 9300°. Time resolved measurements of "wire" resistance etc were made and related to vaporization rates etc.

J.D.Craggs

536.42

5215 ON THE VAPORIZATION EQUILIBRIUM. SYSTEMATIC CONSIDERATIONS AND CALCULATIONS BY MEANS OF ALGEBRAIC EXPONENTS. L.Andrussow.

Z. phys. Chem. (Leipzig), Vol. 212, No. 1-2, 10-28 (1959). In German.

The vapour pressure of mercury has been measured over the range from 10^{-9} to 1.08×10^6 mm Hg. The available data were used to examine series containing two and three terms for the algebraic exponent relating change of vapour pressure to change of temperature. The "temperature exponents" for liquids were found to show a minimum near the critical temperature. Hydrogen, deuterium, and the rare gases have particularly low values, whereas compounds which are easily polymerized or decomposed have high values. The temperature dependence of vapour pressure, viscosity, and heat of vaporization were considered for water, and of the density of liquid and vapour phase for methanol, dimethyl ether, and n-pentane.

R.Schnurmann

536.46

5216 FLAMES: THEIR STRUCTURE RADIATION AND TEMPERATURE. (2nd ed.).

A.G.Gaydon and H.G.Wolfhard.

London: Chapman and Hall (1960) xiii + 383 pp.

A full treatment of the physics of stationary flames. Topics discussed in detail include: measurement of burning velocity; structure of the reaction zone; mechanism of propagation; diffusion flames; solid carbon in flames; vibrating and polyhedral flames; radiation and excitation processes; temperature measurement by spectrum-line reversal and by many other methods; calculation of equilibrium temperature; ionization of flame gases; flames containing nitrogen oxides, boron, fluorine, etc. This edition has been extensively revised, several chapters being entirely re-written with increased emphasis on high energy rocket-type fuels. The emphasis is on the physical principles rather than on either the details of the chemical reactions or on the mathematical interpretations. There are 20 plates, showing photographs of flames and of flame spectra, and over 500 references to the literature.

A.G.Gaydon

536.46

5217 DETERMINATION OF COLLISION FREQUENCY OF FREE ELECTRONS IN FLAMES BY MICROWAVE ABSORPTION MEASUREMENTS.

F.W.Hofmann, H.Kohn and J.Schneider.

Z. Naturforsch., Vol. 14a, No. 11, 998 (Nov., 1959). In German.

Alkali salt solutions fed into the flames form a steady source of electrons. At temperatures 2100-2750°K, collision frequencies of about $20\text{-}27\times10^{10}$ per sec are found.

G.F.Lothian

536.5 : 550.3

5218 TEMPERATURE ERRORS INTRODUCED BY TEMPERATURE-MEASURING PROBES. I.G.Donaldson.

Brit. J. appl. Phys., Vol. 10, No. 6, 252-5 (June, 1959).

Calculations are made of the thermal disturbance produced in

hot ground by the presence of probes that are thermally conducting. It is found that temperatures measured with metal probes with a length/radius ratio of up to 100 : 1 may be considerably in error. Wooden probes are, however, quite satisfactory. For measurements of high accuracy, thermocouple wires alone, i.e. not enclosed in any supporting probe, are quite satisfactory although copper wires should be replaced by manganin if possible. The work has a bearing on surveys being made of the heat flow from thermal regions in New Zealand.

536.53 : 621.317.39

5219 RESISTANCE THERMOMETER SPEAR FOR FIELD MEASUREMENT. A.C.Jason and A.Lees.
J. sci. Instrum., Vol. 36, No. 6, 272-4 (June, 1959).

The instrument described measures temperatures in the range -30° to $+70^\circ$ F with an accuracy of $\pm 0.2^\circ$ F. The sensitive portion consists of a copper wire spiral enclosed in a length of hypodermic tubing; the resistance is measured on a Wheatstone bridge. The instrument is cheap, reliable, robust and self-contained.

536.54

5220 THE DESIGN OF MERCURY THERMOMETERS FOR CALORIMETRY. J.A.Hall and V.M.Leaver.
J. sci. Instrum., Vol. 36, No. 4, 183-7 (April, 1959).

The emergent column error and the uncertainties caused by irregular movement of the meniscus in an open-scale thermometer are discussed. It is considered perferable to calibrate calorimetric thermometers at total immersion unless the ambient temperature in use is considerably below that of the calorimeter. It is shown that irregularity of movement of the meniscus is, to a sufficiently close approximation, proportional to the external pressure coefficient of the thermometer β_e divided by the diameter of the bore d. If these are expressed in deg C $\times$ 0.001/cm of mercury and mm respectively, β_e/d should not exceed 15 when a reproducibility of reading of $\pm 0.002^\circ$ C is desired. Further, is it undesirable to use a capillary having a diameter of less than 60 μm. The paper includes a chart by means of which the appropriate sizes of bulb and capillary tubing for a thermometer of given dimensions and scale length may be selected.

536.58

5221 THERMOSTAT SUITABLE FOR CONTROLLING AIR TEMPERATURE, PARTICULARLY IN BIOLOGICAL RESEARCH. J.W.L.Beament and K.E.Machin.
J. sci. Instrum., Vol. 36, No. 2, 87-9 (Feb., 1959).

Some of the features essential to the control of air temperature in small and unlagged containers are outlined, and apparatus is described which will control the temperature in such a container to $\pm 1/50^\circ$ C. A system of continuous proportional control is used, based on a two-stage directly coupled amplifier whose input is dependent on the resistance of a thermistor, and whose output is fed directly to the heating element. Incorporation of variable positive feedback makes it possible to attain high sensitivity, or alternatively to use the equipment without modification as a switching thermostat and electronic relay for large power loads. A description is also included of a temperature-measuring system based on a thermistor, which will display the air temperature to $\pm 1/50^\circ$ C.

536.58 : 6Z1.316.74

5222 TEMPERATURE CONTROLLER BASED ON MEASUREMENT OF RATE-OF-CHANGE OF TEMPERATURE. A.B.Cairnie and J.D.Pullar.
J. sci. Instrum., Vol. 36, No. 6, 249-52 (June, 1959).

The rate-of-change of temperature of water circulated from a 120 gal tank round the jackets of a direct calorimeter was required never to exceed 0.0005° C/min. Measurement of the rate-of-change of temperature was provided by a gradient layer surrounding a metal block in the tank. A controller was designed to maintain the instantaneous rate-of-change of temperature below 0.0002° C/min, except for a negligible fraction of the time. The mean rate-of-change of temperature is so low that temperature stability to within $\pm 0.1^\circ$ C has been obtained for a fortnight. A temperature-controlled room and constant voltage transformer are not required.

536.63

5223 APPARATUS FOR THE MEASUREMENT OF SPECIFIC HEAT OF METALS. W.H.Martin and J.Rixon.
J. sci. Instrum., Vol. 36, No. 4, 179-82 (April, 1959).

An apparatus is described which enables the measurement of the specific heat of metals to be made in vacuo up to a temperature of at least 500° C. The specimen in the form of a flat cylinder has its temperature steadily increased by a metered amount of electrical energy supplied by an internal heater. Radiative heat losses are eliminated by means of an adiabatic screen which surrounds the specimen and which is maintained at the same temperature. The rate of temperature rise can be controlled by the energy input enabling specific heat to be investigated over small temperature ranges. An accuracy of within $\pm 3\%$ has been obtained at temperatures up to 500° C.

536.63 : 539.2

ELECTRONIC SPECIFIC HEATS OF SOME NICKEL COBALT ALLOYS. See Abstr. 4267

536.65

5224 BULB BREAKING CORRECTION FOR HEATS OF WETTING DETERMINATIONS. R.C.Gallavan.
Brit. J. appl. Phys., Vol. 10, No. 9, 398-9 (Sept., 1959).

Some factors affecting the heat generated when an evacuated glass bulb is broken in water at 25° C have been studied using a calorimeter of high sensitivity. The importance of the gaseous content of the water in the calorimeter is illustrated by deliberate variation of the carbon dioxide content. By careful control of factors discussed, heats of breaking have been measured that are reproducible to ± 0.005 J of the mean value.

536.65

5225 THE LATENT HEAT OF FUSION OF A PHASE OF GALLIUM UNSTABLE AT ATMOSPHERIC PRESSURE. A.Defrain.
C.R. Acad. Sci. (Paris), Vol. 250, No. 3, 483-4 (Jan. 18, 1960). In French.

See Abstr. 12176 (1959). The apparatus used is briefly described. The latent heat of fusion of the 23.3 g of gallium (99.9% pure) used was 9.09 ± 0.03 cal/g in the unstable phase. The apparatus was tested first with 52.4 g of mercury and 2.85 ± 0.02 cal/g obtained for the latent heat of fusion of mercury. The unstable phase would appear to correspond to the solid phase Ga II found at high pressure. S.Weintroub

536.66

5226 SOLUTION-CALORIMETRIC DETERMINATION OF THE HEATS OF FORMATION OF SOLID LEAD–TIN ALLOYS. F.J.Gilhaus.
Z. Naturforsch., Vol. 14a, No. 11, 1001-2 (Nov., 1959). In German.

The preparation of the samples, the method of measurement and the accuracy are discussed. The heats of formation are shown graphically as a function of the mole fraction of tin. S.Weintroub

THERMODYNAMICS

536.7

5227 WELL-INFORMED HEAT ENGINE: EFFICIENCY AND MAXIMUM POWER. C.Finfgeld and S.Machlup.
Amer. J. Phys., Vol. 28, No. 4, 324-6 (April, 1960).

Further analysis is presented of a thought experiment due to Raymond (Abstr. 4358 of 1951), which permits an apparent violation of the second law of thermodynamics (the conversion of heat into work by a cyclic process), utilizing spontaneous fluctuations, and supplying the negentropy in the form of information obtained by counting. The thermodynamic efficiency of the heat engine itself is unity; considering the engine and counting demon together preserves the sanctity of the second law. An expression is derived for the power delivered by the engine, and the maximum value of this expression is studied as a function of the various parameters.

LOW-TEMPERATURE PHYSICS

536.48

5228 THE SPECIFIC HEAT C_V OF LIQUID HELIUM NEAR THE λ-CURVE AT VARIOUS DENSITIES. O.V.Lounasmaa and E.Kojo.
Ann. Acad. Sci. Fennicae A VI, No. 37, 25 pp. (1959).

Measured from 1.5 to 2.8° K at various densities between, and on, the liquid–vapour and liquid–solid equilibrium lines. The results show quite clearly that the height of the λ-peak diminishes when

density is increased, although the peak is still very pronounced along the liquid–solid equilibrium line. Smoothed values of C_V as a function of density and temperature are tabulated and an entropy diagram is also calculated. The estimated accuracy of the C_V measurements is 2% below and 1% above the λ-point. The λ-curve has been determined.

536.48

5229 "EDDY" VISCOSITY IN LIQUID HELIUM II. S.M.Bhagat.

Proc. Phys. Soc., Vol. 75, Pt 2, 303-5 (Feb., 1960).

Isothermal flow of liquid helium II through a wide capillary has been studied. The flow of the liquid is found to be complex and to obey a modified form of Poiseuille's law. Further, the effective viscosity thus deduced varies fairly strongly with the initial pressure difference. A possible explanation, introducing an "eddy" viscosity in the superfluid, is suggested.

536.48

5230 SELF-DIFFUSION IN LIQUID He^3. H.R.Hart, Jr and J.C.Wheatley.

Phys. Rev. Letters, Vol. 4, No. 1, 3-5 (Jan. 1, 1960).

The self-diffusion coefficient D of liquid He^3 has been measured in the temperature range from 0.067° to 2.97°K at pressures near the saturated vapour pressure, using the method of spin echoes (Abstr. 2922 of 1951; 6788 of 1954; 1069 of 1960). The results indicate that D goes through a minimum of 6×10^{-5} cm^2/sec near 0.55°K and increases rapidly below 0.2°K, as predicted by Pomeranchuk (Abstr. 9427 of 1951), Landau (Abstr. 8604 of 1956) and Abrikosov and Khalatnikov (Abstr. 4527 of 1959). H.London

536.48

5231 VAPOR PRESSURE OF He^3–He^4 SOLUTIONS. A.K.Sreedhar and J.G.Daunt.

Phys. Rev., Vol. 117, No. 4, 891-6 (Feb. 15, 1960).

Measurements were made of the vapour pressures of solutions of He^3 in He^4 having molar He^3 concentrations 1.91, 3.34, 6.51, and 12.04% in the temperature range 1.4° to 2.6°K. The measurements involved the observation of the excess pressure of the solution over that of pure liquid He^4 which was carefully maintained at the same temperature as the solution using an apparatus which ensured high precision of pressure transmission between the low- and high-temperature parts of the apparatus, especially for liquid He^4 temperatures above the lambda temperature. The results are compared with previous evaluations and comparisons made with recent theories of He^3–He^4 solutions.

536.48 : 535.37 : 532.7

SCINTILLATIONS FROM LIQUID HELIUM. See Abstr. 5030

536.48

5232 A METHOD FOR MEASURING MAGNETIC FIELDS IN SUPERCONDUCTORS. H.R.Lewis, J.F.Cochran, H.Frauenfelder, D.E.Mapother and R.N.Peacock.

Z. Phys., Vol. 158, No. 1, 26-35 (1960).

The magnetic field strength inside a superconductor is measured by the rotation of the angular correlation between the two γ-rays in a γ–γ nuclear decay. The radioactive isotope needed for this is introduced by an evaporation technique. Attempts to study penetration in lead are described, but experimental success is limited to an observation of the Meissner effect. L.Mackinnon

536.48

5233 THE MEISSNER EFFECT, GAUGE INVARIANCE AND ELECTRON CORRELATIONS. G.L Sewell.

Proc. Phys. Soc., Vol. 74, Pt 3, 340-9 (Sept., 1959).

A perturbative method, which is gauge invariant in infinite order, is employed to investigate whether the Bardeen, Cooper and Schrieffer–Bogolyubov treatment of the theory of superconductivity leads to the Meissner effect. It is found that the theory does not reveal, in any finite order of perturbation, the long range correlations between the electronic momenta that are necessary for the Meissner effect.

536.48

5234 QUASI-PARTICLES AND GAUGE INVARIANCE IN THE THEORY OF SUPERCONDUCTIVITY. Y.Nambu.

Phys. Rev., Vol. 117, No. 3, 648-63 (Feb. 1, 1960).

Ideas and techniques known in quantum electrodynamics have been applied to the Bardeen–Cooper–Schrieffer theory of superconductivity (Abstr. 6193 of 1957; 1708 of 1958). In an approximation which corresponds to a generalization of the Hartree–Fock fields, one can write down an integral equation defining the self-energy of an electron in an electron gas with phonon and Coulomb interaction. The form of the equation implies the existence of a particular solution which does not follow from perturbation theory, and which leads to the energy gap equation and the quasi-particle picture analogous to Bogoliubov's (Abstr. 7034, 7036 of 1959). The gauge invariance, to the first order in the external electromagnetic field, can be maintained in the quasi-particle picture by taking into account a certain class of corrections to the charge-current operator due to the phonon and Coulomb interaction. In fact, generalized forms of the Ward identity are obtained between certain vertex parts and the self-energy. The Meissner effect calculation is thus rendered strictly gauge invariant, but essentially keeping the BCS result unaltered for transverse fields. It is shown also that the integral equation for vertex parts allows homogeneous solutions which describe collective excitations of quasi-particle pairs, and the nature and effects of such collective states are discussed.

536.48

5235 SUPERCONDUCTIVITY OF CONTACTS WITH INTERPOSED BARRIERS. H.Meissner.

Phys. Rev., Vol. 117, No. 3, 672-80 (Feb. 1, 1960).

For previous work, see Abstr.8789 (1958); 12298 (1959). Resistance versus current diagrams and "Diagrams of State" have been obtained for 63 contacts between crossed wires of tin. The wires were plated with various thicknesses of the following metals: copper, silver, gold, chromium, iron, cobalt, nickel, and platinum. The contacts became superconducting, or showed a noticeable decrease of their resistance at lower temperatures if the plated films were not too thick. The limiting thicknesses were about 35×10^{-6} cm for Cu, Ag, and Au; 7.5×10^{-6} cm for Pt, 4×10^{-6} cm for Cr, and less than 2×10^{-6} cm for the ferromagnetic metals Fe, Co, and Ni. The investigation was extended to measurements of the resistance of contacts between crossed wires of copper and gold plated with various thicknesses of tin. Simultaneous measurements of the (longitudinal) resistance of the tin-plated gold or copper wires showed that these thin films of tin do not become superconducting for thicknesses below certain minimum values. These latter findings are in agreement with previous measurements at Toronto. The measurements at Toronto usually were believed to be unreliable because films of tin evaporated into quartz substrates can be superconducting at thicknesses as small as 1.6×10^{-6} cm. It is now believed that just as superconducting electrons can drift into an adjoining normal conducting layer and make it superconducting, normal electrons can drift into an adjoining superconducting layer and prevent superconductivity.

536.48

5236 THE PROBABLE EXISTENCE OF SUPERCONDUCTING ELEMENTS WITH EXTREMELY LOW TRANSITION TEMPERATURES. B.B.Goodman.

C.R. Acad. Sci. (Paris), Vol. 250, No. 4, 683-5 (Jan. 25, 1960). In French.

Among 22 superconductors, the parameter N_0V of the B.C.S. theory appears to follow a Gaussian distribution, as might be expected a priori. Extrapolation suggests that there may exist about five more elements with transition temperatures above 10^{-3} °K, and another five in the range 10^{-3} to 10^{-6} °K. R.G.Chambers

536.48

5237 SUPERCONDUCTIVITY OF AuBe. B.T.Matthias.

J. Phys. Chem. Solids, Vol. 10, No. 4, 342-3 (Aug., 1959).

This compound has the cubic FeSi-type structure (B20) and becomes superconducting at 2.64°K. It is believed that in this compound the number of gold valence electrons is eleven. H.London

536.48

5238 INVESTIGATIONS ON SUPERCONDUCTING SINGLE LAYER COILS AND ON HOLLOW CYLINDERS WITH A CIRCULAR CURRENT [LOAD]. F. von Ballmoos.

Z. angew. Phys., Vol. 12, No. 1, 1-5 (Jan., 1960). In German.

The intermediate state of a superconducting hollow cylinder which carries a circular current is described. With a super-critical axial magnetic field inside the cylinder and zero field outside the critical current I_c flows in an thin layer at the outer surface of the cylinder independent of the value of the magnetic field inside. This layer is in the intermediate state, the current passing through alternate superconducting and normal regions. The proportion of the

latter depends on the circular electric field. This in turn is proportional to the current flowing in the remaining lower part of the cylinder which is in the normal state, and causes the axial magnetic field to decrease towards the critical value H_c with increasing radius. On the basis of this model the transition curve is given by $R/R_n = 1 - H_c/H$. Measurements with a coil wound from indium ribbon show that below 3.2°K the measured curve agrees well with the calculated one; nearer to the critical temperature are comparatively large deviations. Dynamic measurements on a hollow cylinder of tin show a similar behaviour. H.London

536.48 : 538.23

5239 ON THE INFLUENCE OF ADSORBED GASES ON THE SUPERCONDUCTIVITY OF THIN THALLIUM FILMS.

W.Rühl.
Z. Phys., Vol. 157, No. 2, 247-65 (1959). In German.

Thin Tl films were made by evaporation on crystalline quartz at temperatures between 3° and 90° K and the transition curves to superconductivity were investigated with high relative accuracy. By adding subsequently defined quantities of O_2, N_2 and H_2 it was shown that the transition temperature decreased continuously with increasing coverage of the surface. Finally a state of saturation was obtained, after which the transition temperature stayed practically constant. With films of 200-300 A deposited at 3°K, the decrease was $1\text{-}2 \times 10^{-2}$ °K. Also without deliberate addition of gas the transition temperature decreased at a rate of $\sim 5 \times 10^{-4}$ °K in 15 min. This was due to residual gases. (The pressure is estimated to be $< 10^{-9}$ mm Hg). H.London

536.48 : 621.374.32

5240 REFRIGERATION OF A SUPERCONDUCTING MEMORY FOR A COMPUTER. A.C.Rose-Innes.
Brit. J. appl. Phys., Vol. 10, No. 10, 452-4 (Oct., 1959).

An estimate is made of the refrigeration, in terms of consumption of liquid helium, required to maintain at low temperature a memory of superconducting cells. Using commercially available cable, the major source of heat is thermal conduction down the leads to the memory. If a cable of low thermal conductivity is used, a memory of one million cells should not consume more than about 2l. of liquid helium per hour. The optimum size for copper electrical leads running directly from room temperature to liquid helium is calculated.

536.48 : 539.2 : 537.3

SUPERCONDUCTIVITY OF METASTABLE U-RICH ALLOYS.
See Abstr. 4320

536.48

5241 CRYOSTAT FOR MEASURING THE ELECTRICAL PROPERTIES OF HIGH RESISTANCE SEMICONDUCTORS AT LOW TEMPERATURES. W.H.Mitchell and E.H.Putley.
J. sci. Instrum., Vol. 36, No. 3, 134-6 (March, 1959).

This apparatus enables measurements to be made on semiconductors of resistance up to 10^{11} Ω at temperatures down to 2°K. A vibrating reed electrometer is used for the measurements. The characteristics of suitable instruments are described and the performance of the apparatus is illustrated by showing some results obtained for a specimen of gold doped silicon. The maximum specimen resistance which can be used is determined by the self-capacity of the apparatus. The noise level in the electrometers sets a lower limit for the measurement of Hall mobility at about $10\ cm^2\ V^{-1}\ sec^{-1}$.

536.48 : 539.2 : 548.7

LIQUID-HELIUM GONIOMETER-MOUNTED CRYOSTAT FOR A SINGLE CRYSTAL AUTOMATIC NEUTRON DIFFRACTOMETER.
See Abstr. 4614

536.48

5242 AN INSTRUMENT WHICH AUTOMATICALLY MAINTAINS A CONSTANT LEVEL OF LIQUID NITROGEN IN A DEWAR. V.P.Bykov and V.N.Kostryukov.
Pribory i Tekh. Eksper., 1959, No. 3, 154 (May-June). In Russian.

As the level of the liquid nitrogen falls, a small reservoir of liquid oxygen evaporates and the resultant rise in oxygen pressure is used to operate a valve which recharges the Dewar with nitrogen. M.G.Priestley

ELECTRICITY
ELECTRICAL MEASUREMENTS

537.7

5243 MEASUREMENT OF MICROWAVE RESISTIVITY BY EDDY CURRENT LOSS IN SPHERES.

T.Kohane and M.H.Sirvetz.
Rev. sci. Instrum., Vol. 30, No. 11, 1059-60 (Nov., 1959).

A method has been developed for measurements on spherical samples (radius a) of comparatively low resistivity ($\rho \sim 0.01$ ohm cm). A formula for the power dissipated as a result of eddy currents is used to relate a function of ρ/a^2 to quantities which can be measured or calculated. A graph of this function enables the resistivity to be obtained. Measurements are required of the Q of the cavity and of the ratio of the resonance transmissions with and without the sample present. Experimental results on doped Ge and Si are in good agreement. For ferrites a large magnetic field is used to reduce the effective permeability to that of free space. R.C.Kell

537.7 : 621.317.37

5244 STROBOMETRIC METHOD OF MEASURING THE PHASE ANGLES OF VERY LOW CURRENTS.

S.B.Girvan and D.S.McIlhagger.
J. sci. Instrum., Vol. 36, No. 6, 283-4 (June, 1959).

A simple device for measuring the phase angle of mains-frequency currents with respect to the applied voltage, to an accuracy of ±0.5°. The method was used with currents in the range 0.01 to 10.0 μA but is not restricted to this range.

537.7 : 621.317.755

5245 PHOTOGRAPHIC METHOD FOR PULSE AMPLITUDE ANALYSIS. P.J.Kennedy and P.J.Dean.
J. sci. Instrum., Vol. 36, No. 3, 126-9 (March, 1959).

A method is described by which pulse height spectra may be obtained by photographic a c.r.o. display, in which only the tops of the pulses appear on the screen. The time base is switched off and the exposure is adjusted to permit the film to integrate the blackening due to a large number of individual pulse tops. The density variation on the film may be shown to be closely related to the pulse height spectrum and may be obtained from a densitometer measurement. Full details are given of the circuits used to obtain such a display, together with a summary of the applications to which the technique is particularly suited.

537.7 : 621.373.4 : 621.316.726

5246 AUTOMATIC Q-METER PEAKING CIRCUIT. F.M.Wanlass.
Rev. sci. Instrum., Vol. 31, No. 2, 199-201 (Feb., 1960).

The circuit, when used with an ordinary Q meter, will measure the Q and the capacitance of a low loss sample in parallel across the Q-meter tank circuit rapidly and continuously without the necessity of constant hand tuning of the tank circuit to resonance. Employing this circuit, it is possible to observe Q and capacitance changes that have a time constant of 0.3 sec or greater.

537.7 : 621.375.222

5247 TRANSIENT RESPONSE OF DIRECT CURRENT AMPLIFIER SYSTEMS. R.D.Stuart.
Brit. J. appl. Phys., Vol. 10, No. 7, 326-8 (July, 1959).

The transient response of a direct current amplifier to a step function input current, is compared with its response to a spurious charge suddenly induced on the capacitance across the grid of the first valve. The behaviour of circuits consisting of simple RC networks is considered first, and this is then compared with the behaviour of a system containing an amplifier with feedback. It is shown that the problem of improving the signal-to-noise ratio for this case is one of filtering, and can be considered independently of any characteristics introduced into the system by feedback.

537.7 : 621.375.23

5248 APPLICATION OF DELAYED FEEDBACK IN ELECTRONIC CIRCUITS. Z.Naray.
Brit. J. appl. Phys., Vol. 10, No. 9, 400-3 (Sept., 1959).

By the use of suitable delayed feedback (d.f.b.) from the output terminals of a four- (or two-) pole network to the input, a great variety of different signals can be generated, the shape of which is determined by the characteristics of the four- (or two-) pole network, the d.f.b. loop and, under certain conditions, by the shape and duration of the trigger signal which is needed to set the d.f.b. system

in operation. Two simple applications of delayed feedback in electronic circuits (where the loop gain is real and equal to or less than unity) are given: (1) the output of a phase-inverting amplifier (amplification, $-g$) is fed by a delay line (delay time τ) to the input of the amplifier. If $|g|v \cong 1$ (where v is the loss in the d.f.b. loop), periodic signals of frequency $f \cong 1/2\tau$ are generated. (b) If, in the same arrangement as (a), $|g|v < 1$, an output signal is produced only if a trigger signal is fed into the d.f.b. loop; that is, the circuit works as a triggered oscillator of frequency $f \cong 1/2\tau$. Because of mixing (additive or multiplicative) between the trigger signal of duration T and the d.f.b. signal, the shape of the output signal depends on the value T/τ. By investigation of the output signal with a frequency meter or oscilloscope, the delay time of an unknown element (delay line e.g. amplifier) connected in the feedback loop can be measured. The d.f.b. oscillators have a frequency stability of about 10^{-5}/h.

ELECTROSTATICS . DIELECTRICS

(The study of solids through their dielectric properties is included under Solid-State Physics; similarly for Liquid State and Gaseous State)

537.2 : 532.6

METHOD OF VIRTUAL WORK FOR A PROBLEM IN ELECTROSTATICS. See Abstr. 5006

537.2 : 536.7

5249 ON THE IRREVERSIBLE THERMODYNAMICS OF THE VOLTA-EFFECT. I.Kirschner.

Acta phys. Hungar., Vol. 10, No. 4, 351-8 (1959).

The non-stationary irreversible process giving rise to this effect is investigated qualitatively.

537.2

5250 FIELD OF A LINEAR ELECTROSTATIC MULTIPOLE. L.J.Laslett.

Amer. J. Phys., Vol. 26, No. 6, 402-3 (Sept., 1958).

It is suggested that the generation of multipole potentials by differentiation is a useful basic concept which affords a means of readily obtaining a simple equation describing the lines of force of a linear multipole. It is noted that certain features of the lines of force can be found without using the equation for these curves in their integrated form.

537.2

5251 NOTE ON THE ELECTRIFIED SPHERICAL CAP. W.D.Collins.

Proc. Cambridge Phil. Soc., Vol. 55, Pt 4, 377-9 (Oct., 1959).

The surface density of electric charge induced on a thin uniform spherical cap, kept at constant potential in an external electrostatic field, is solved for the case when the perturbation potential can be expanded as a series of terms : $\sin^n \theta\ F(\cos\theta) \cos\{n(\phi + \beta)\}$, where θ, ϕ are spherical polar coordinates (while the cap occupies $0 \leq \theta \leq \alpha$), n is an integer, β is a constant and F is given function.

J.K.Skwirzynski

537.2

5252 ON THE CAPACITY OF A SPHERE INSIDE A CUBE. F.W.de Wette.

Proc. K. Ned. Akad. Wetensch. B, Vol. 63, No. 1, 108-12 (1960).

A capacitor consisting of a conducting sphere placed concentrically inside a conducting cube is considered. A rapidly converging expression for its capacity C is derived with the aid of a method which has been developed for the description of electrostatic fields in ionic crystals. Two approximations for C are discussed.

537.2

5253 SERIES EXPANSION OF A CYLINDRICAL POTENTIAL IN THE VICINITY OF THE BOUNDARY OF A SURFACE DISTRIBUTION OF CHARGES: DEVELOPMENT OF SERIES AND ITS DETERMINATION BY MEANS OF FINITE DIFFERENCES. P.Durand.

C.R. Acad. Sci. (Paris), Vol. 249, No. 19, 1864-6 (Nov. 9, 1959). In French.

The author considers potential in the vicinity of a charged surface, coinciding with the whole or a portion of the (yz) plane in cartesian space. The coefficients of postulated polar expansions of potential on both sides and in front of the charged surface are correlated by means of surface boundary conditions. When the distribution of charges is limited to a half-plane, an appropriate series of logarithmic terms is added to the expansion. The method of finite differences (relaxation method) is then used to determine iteratively the coefficients of expansion of potential.

J.K.Skwirzynski

537.2 : 621.315.611

5254 MEASUREMENT AND INFLUENCE OF SURFACE CHARGES IN HIGH-VOLTAGE PHENOMENA. S.I.Reynolds.

Elect. Engng, Vol. 78, No. 11, 1090-4 (Nov., 1959).

A discussion of the formation of positive and negative charges left on the surface of insulation as a result of the electric discharge between a metal and a dielectric surface. Results of measurements with the rotating probe electrometer are given.

537.2

5255 THE EQUILIBRIUM OF A DOUBLE LAYER. R.Cade.

Proc. Phys. Soc., Vol. 74, Pt 3, 368-77 (Sept., 1959).

Generally, a body immersed in a fluid is surrounded by an electric double layer at least part of which resides in the fluid. In a previous paper (Abstr. 11037 of 1954) (which contains an error corrected in the present paper), it was found that the double layer must satisfy certain conditions of macroscopic theory in order to be in equilibrium. In this paper it is shown that the conditions can be simultaneously satisfied, but not uniquely so, so that they do not determine the structure of the double layer, although in certain circumstances, they determine it partially. A discussion is given of the relationship of the present theory to the microscopic theory, and its role in relation to that theory.

537.2 : 536.24

5256 ELECTRIC STRESS AND HEAT TRANSFER. P.H.G.Allen.

Brit. J. appl. Phys., Vol. 10, No. 8, 347-51 (Aug., 1959).

Apparent contradictions in published reports of the effect of electric stress on heat transfer in fluids have been resolved by small-scale experiments and by reanalysis of available data. The effect of deliberately mixed unidirectional and alternating stress has been investigated for the first time. While alternating stress increases heat transfer in its presence, purely unidirectional stress inhibits it, while "mixed" stress may have either effect according to the magnitude of its components.

537.2

5257 DIELECTRIC PROPERTIES OF WATER/ALUMINA. J.L.Wood.

Brit. J. appl. Phys., Vol. 10, No. 9, 404-6 (Sept., 1959).

The real and imaginary components of the dielectric constant of activated alumina powder containing various quantities of water have been measured at temperatures from 0-29.8°C, and at frequencies from 40 c/s to 100 Mc/s. The loss observed in this frequency range is ascribed to a Wagner-type mechanism. No discontinuity in the dielectric properties of the medium was observed.

537.2 : 621.317.723

5258 ELECTROMETER FOR MEASURING THE VARIATION WITH CONCENTRATION OF THE LOW FREQUENCY DIELECTRIC CONSTANT OF AQUEOUS IONIC SOLUTIONS. V.I.Little.

J. sci. Instrum., Vol. 36, No. 3, 129-32 (March, 1959).

A new electrometer is described which enables measurements to be made of the dielectric constants of aqueous ionic liquids, in terms of that of pure water, up to concentrations of about 10^{-2}N. The method depends on the observation of a null point when two couples acting upon an electrode suspended in the liquid are equal. One couple depends on electric forces and varies directly with the dielectric constant, whilst the other couple is magnetic and may be made proportional to the value of an external resistance. The probable error in the final results is of the order 0.5%.

537.2

5259 DIELECTRIC MEASUREMENTS ON THIN FILMS BY MEANS OF ELECTRODES COATED WITH IRRADIATED SILICONE RUBBER. W.P.Baker and F.B.Waddington.

J. sci. Instrum., Vol. 36, No. 7, 309-12 (July, 1959).

The method involves the use of electrodes faced with a rubber-like material and it is found that irradiated polydimethylsiloxane is

the only material which is entirely satisfactory for the coating of electrodes. In conclusion, an electrode assembly with which the technique has been proved is described.

537.2 : 539.2

5260 ELECTROMAGNETIC PROPERTIES OF INSULATORS. I. V.Ambegaokar and W.Kohn.

Phys. Rev., Vol. 117, No. 2, 423-31 (Jan. 15, 1960).

The response of a perfect insulator to weak external electromagnetic fields of long wavelength is discussed from a many-particle point of view. The method is to treat the Coulomb interaction between all electrons to all orders of perturbation theory and analyse the structure of the corresponding Feynman graphs. As a result of this graphical analysis the authors are able to show that the response of the many-particle system to long wavelength external fields of arbitrary polarization is completely described by a single frequency-dependent dielectric constant. In the limit of long wavelengths as well as low frequencies, the treatment also includes in terms of a magnetic permeability, the magnetic effects of an external field on the system.

537.2 : 621.319.2

5261 DECAY OF WAX ELECTRETS. M.M.Perlman.

J. appl. Phys., Vol. 31, No. 2, 356-7 (Feb., 1960).

The internal field within an electret can be varied by changing the spacing and arrangement of shielding electrodes ("partial shielding"). The application of this technique to rosin-wax electrets shows that the charge decay observed upon unshielding electrets is caused primarily by volume polarization due to internal field rather than by external ion collection.

537.2 : 621.317.735

5262 IMPROVED CIRCUIT FOR THE MEASUREMENT OF THE DIELECTRIC CONSTANTS OF GASES. E.J.Gauss and T.S.Gilman.

Rev. sci. Instrum., Vol. 31, No. 2, 164-5 (Feb., 1960).

Chien's apparatus [Journal of Chemical Education, Vol. 24, 494 (1947)] for the measurement of dielectric constants has been modified by the use of a Clapp oscillator. The measuring cell and the technique used to detect capacitance differences of about 10^{-3} pF are described.

CURRENT ELECTRICITY ELECTROKINETICS

(The study of solids through their electrical conduction properties is included under Solid-State Physics)

537.3

5263 INVESTIGATION OF ELECTRIC CONTACTS IN THE ELECTRON MICROSCOPE. G.A.Bogdanovskii.

Fiz. tverdogo Tela, Vol. 1, No. 8, 1281-8 (Aug., 1959). In Russian.

Experimental studies of the behaviour of electric contacts separated by only a few microns are difficult to make because it is not usually possible to observe the surfaces at high magnifications. In addition the applied electric field distorts the surfaces making static experiments difficult. By mounting a pair of contacts in the specimen stage of an electron microscope the gap can be observed continuously at high electron-optical magnification whilst dynamical experiments are performed. Electron micrographs are shown illustrating the formation of sharp points on the cathode and long dendrites on the anode prior to complete breakdown and bridging over of the gap under an applied electric field which may attain a value of several million volts per centimetre. These pictures may be correlated with the measured volt-amp characteristics of the gap. T.Mulvey

537.3 : 621.314.58

5264 USE OF A THERMISTOR AS A D.C.–A.C. CONVERTER. N.W.Bell.

Rev. sci. Instrum., Vol. 31, No. 1, 65 (Jan., 1960).

A thermistor was used in a negative feedback amplifier for d.c. to a.c. conversion at a frequency of 30 c/s and with a zero drift of 10 μV per day. A.J.Ingels

537.312

5265 SOLAR BATTERIES.ON THE DIRECT CONVERSION OF RADIATION INTO ELECTRICAL ENERGY BY MEANS OF PHOTOELEMENTS. V.S.Vavilov.

J. nuclear Energy, Vol. 4, No. 2, 235-46 (Feb., 1957). English translation of article in: Atomnaya Energiya, Vol, 1, No. 3, 107 (1956).

The possibilities are examined of direct conversion of the energy of solar radiation into electrical energy by means of semiconductor photoelements. The basic electrical and optical properties of germanium and silicon crystals are briefly described, as well as methods of producing them and regulating their electrical properties by the introduction of small amounts of "dope". The principles of the action of photoelements are examined and the basic parameters determining their spectral sensitivity and efficiency are discussed. Data are adduced on the functioning of experimental solar batteries used as generators.

537.32

5266 AN EXPERIMENTAL INVESTIGATION OF A THERMOELECTRIC EVAPORATOR. V.A.Naer.

Fiz. tverdogo Tela, Vol. 1, No. 8, 1193-7 (Aug., 1959). In Russian.

Details of construction and working data given (for water). By using the heat of condensation of the evaporated liquid and maintaining a small temperature difference, ΔT, between the hot and cold junctions a high thermal coefficient is obtained. For ΔT = 5-7 deg C the electrical energy required can be 8-7 times less than that for conventional electrical heating. R.Berman

537.36

5267 THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE FREQUENCY DEPENDENCE OF THE ELECTROKINETIC EFFECT (STREAMING CURRENT) IN POROUS GLASS FILTER-PLATES WITH ULTRASOUND. W.Eisenmenger.

Acustica, Vol. 7, No. 1, 45-56 (1957). In German.

The frequency dependence of the electrokinetic alternating potential in porous glass filters is investigated over the range from 20 to 250 kc/s. The filter plates were placed in a measuring cell filled with distilled water, hanging freely parallel to the wave front of a plane ultrasonic field. With fine pores, the sensitivity increases directly with frequency, but with large pores it is proportional to the square root of the frequency, and in the latter the phase of the alternating potential is 45° to that in the former. The results are compared with calculations made on a hydrodynamic model. The relative sensitivity — anternating to direct — agrees well with that derived from the model. A new electrokinetic probe microphone is developed with a constant sensitivity of −123 dB (0 dB ≡ 1 V/μbar) in the range from 20 to 100 kc/s.

537.36

5268 ELECTROKINETIC EFFECTS IN LIQUID METALS. I. G.E.Pikus and V.B.Fiks.

Fiz. tverdogo Tela, Vol. 1, No. 7, 1062-71 (July, 1959). In Russian.

In a capillary tube or thin film of liquid metal carrying an electric current, there is a tangential force on the liquid at the wall, caused by non-specular scattering of electrons there. This force produces either a net flow of the liquid or (if the net flow is prevented) an electro-osmotic" pressure gradient together with a circulation of the liquid. A quantitative theory of these effects is given here. The magnitude of the effects is estimated numerically for Na, K, Li, and Hg. O.Penrose

537.36 : 532.5

ELECTROKINETIC EFFECTS AND ELECTRONIC VISCOSITY IN LIQUID METALS. See Abstr. 4997

537.36

5269 THE TEMPERATURE DEPENDENCE OF THE ELECTRO-OSMOSIS OF MERCURY. H. Knof and A. Klemm.

Z. Naturforsch., Vol. 14a, No. 12, 1020-3 (Dec., 1959). In German.

(See Abstr. 8181 of 1959). An experimental study of the variation of the electrokinetic mobility of mercury with temperature (− 20° to 278°C) and with the wall material (glass, Fe, Pt and Ge). The apparatus and method are fully described. The mobility α rises from 1.7×10^{-9} cm²/V sec at − 20°C to a maximum 4.0×10^{-9} cm²/V sec at 165°C and then falls to 3.0×10^{-9} cm²/V sec at 278°C, and this variation agrees with the theory that α is proportional to $\lambda_\infty^2/\eta_\infty$ where λ_∞ is the m.f.p. of the conduction electrons and η_∞ is the viscosity. The theoretical values for α are however ten times too large. α is apparently independent of the wall material. S.Weintroub

IONIZATION

537.56

5270 MEASUREMENT OF IONIZATION AND ATTACHMENT COEFFICIENTS IN DRY AIR IN UNIFORM FIELDS AND THE MECHANISM OF BREAKDOWN. A.N.Prasad.
Proc. Phys. Soc., Vol. 74, Pt 1, 33-41 (July 1, 1959).

Measurements of pre-breakdown currents in uniform field conditions in dry air in the E/p range of 25 to 45 V cm^{-1} (mm Hg)$^{-1}$ over the pressure range 60—700 mm Hg indicate the presence of appreciable attachment. Assuming dissociative attachment as the mechanism of negative-ion formation, it is shown that the growth of current at constant E/p can be represented by the Townsend equation corrected for the removal of electrons from the swarm by attachment. From the semi-logarithmic plots of current against electrode separation, employing this equation the Townsend ionization coefficients α and γ and an attachment coefficient η are evaluated by curve fitting techniques. From the values of attachment coefficient, assuming a Maxwellian distribution, attachment cross-sections for various mean electron energies have been evaluated and agree well with earlier measurements. Further, static breakdown potentials have been measured up to pd~1200 mm Hg cm. Employing the values of α, γ and η, and the breakdown criterion as derived from the modified Townsend equation, static breakdown potentials have been derived and agree well with measured values, thus confirming the validity of the Townsend build up mechanism.

537.56

5271 FIRST IONIZATION COEFFICIENTS IN HYDROGEN, NEON, AND ARGON. D.E.Davies and J.G.C.Milne.
Brit. J. appl. Phys., Vol. 10, No. 7, 301-6 (July, 1959).

Values of the first ionization coefficient η in hydrogen have been determined in the range $40<E/p_0<500$ V cm^{-1} mm^{-1} of mercury at 0°C to ± 2% (where E is field strength and p_0 the gas pressure at 0°C). Evaporated metal film electrode tubes have been developed so that rigorous outgassing procedures could be adopted, and an analysis has been used whereby the values of η can be correctly calculated from the current-voltage data. Preliminary results have also been obtained for neon and argon (commercial spectroscopically pure) using the same techniques.

537.56

5272 THE STRUCTURE OF A STREAM OF ELECTRONS AND IONS DRIFTING AND DIFFUSING IN A GAS WHEN IONIZATION BY COLLISION AND MOLECULAR ATTACHMENT ARE PRESENT. L.G.H.Huxley.
Austral. J. Phys., Vol. 12, No. 2, 171-83 (June, 1959).

The theory is developed of the structure of a stream of electrons and ions drifting under the action of a uniform field and diffusing in a gas when either or both ionization by collision and electron attachment are present. The cases considered include a point source and a line source, and in the latter case the influence of a magnetic field is discussed. The investigation provides a theoretical basis for methods of measuring electron attachment, about to be put into practice.

537.56 : 538.3

IONIZATION BY PISTON-GENERATED SHOCK WAVES.
See Abstr. 3842

537.56

5273 ELECTRON ATTACHMENT IN $C_6F_{10}O$.
J.von Hoene and W.M.Hickam.
J. chem. Phys., Vol. 32, No. 3, 876-9 (March, 1960).

The negative ion spectrum of $C_6F_{10}O$ at low electron energies was obtained using the mass spectrometer. The most intense peaks are identified as $C_6F_{10}O^-$, $C_7F_{14}^-$, $C_5F_9O^-$, $C_4F_8O^-$, $C_4F_7O^-$, $C_3F_6O^-$, and CF_3O^- ions. Formation of the CF_3O^- ion requires a rearrangement process. Appearance potentials and attachment energy ranges of the most intense peaks are given. Positive and negative ion fragmentation of the molecule is discussed relative to the components of the mixture, perfluoro-2-butyltetrahydrofuran and perfluoro-2-propyltetrahydropyran and its separation.

537.56

5274 ELECTRON VELOCITY DISTRIBUTIONS IN A PARTIALLY IONIZED GAS. H.Dreicer.
Phys. Rev., Vol. 117, No. 2, 343-54 (Jan. 15, 1960).

The Boltzmann method is applied to the problem of calculating the electron velocity distribution in a partially ionized gas. Inelastic collisions with neutral molecules as well as random two-body Coulomb interactions are included. The latter are treated by use of the Fokker—Planck equation. Application is made to a hydrogen plasma subjected to an externally applied electric field. Static solutions are obtained, by numerical means, as a function of the ionization degree, and the classical gas discharge parameter, E/p. It is shown that the evolution of the electron velocity distribution function from that characteristic of a poorly ionized gas to the Maxwellian distribution occurs over a very large range in ionization degree. Several applications are also made to energy relaxation phenomena, and the electrical conductivity is evaluated.

537.56 : 621.387

5275 ION ENERGIES IN A COLD CATHODE DISCHARGE IN A MAGNETIC FIELD. J.Backus and N.E.Huston.
J. appl. Phys. Vol. 31, No. 2, 400-3 (Feb., 1960).

A cold-cathode discharge in a strong magnetic field was studied by means of a pulsing technique. The discharge was run at pressures of a few microns with magnetic field of 2.4 kG and current ~ 0.5 A. By means of a multivibrator and amplifier the discharge was pulsed off for 300 μsec at 1000 μsec intervals. During the off-period the current flow to the cathodes was observed. Analysis of the current flow shows an approximately Maxwellian distribution of velocities at the cathodes with a temperature of about 0.5 eV. This gives an ion density in the discharge of approximately 20%.

537.56

5276 FIELD INSTABILITIES IN GASES, DUE TO DIFFUSION, BELOW THE STATIC BREAKDOWN FIELD STRENGTH. H.Rother.
Z. Phys., Vol. 157, No. 3, 326-34 (1959). In German.

A theoretical treatment of space charge effects, including the influence of attachment processes, in ionized gases. Diffusion waves arising from localized carrier density variations are discussed in some detail. J.D.Craggs

537.56

5277 ELECTRON ATTACHMENT COEFFICIENTS IN OXYGEN, DRY AIR, HUMID AIR AND WATER VAPOUR. E.Kuffel.
Proc. Phys. Soc., Vol. 74, Pt 3, 297-308 (Sept., 1959).

Electron attachment coefficients were measured in oxygen, dry air, air saturated with water vapour at room temperature and in water vapour. An electron filter type apparatus was used. The results have been compared with those of other workers. An approximate evaluation has been made of the influence of humidity on the breakdown voltage of air gaps in a uniform field using the present results and the known ionization coefficient data.

537.56

5278 ELECTRON LOSS FROM FAST NEGATIVE IONS OF ATOMIC HYDROGEN PASSING THROUGH ATOMIC HYDROGEN. M.R.C.McDowell and G.Peach.
Proc. Phys. Soc., Vol. 74, Pt 4, 463-72 (Oct. 1, 1959).

Born's approximation is used to calculate the cross-sections of the processes

$$H(1s) + H^-(1s^2) \rightarrow H(1s \text{ or } 2p) + H(1s \text{ or } 2p) + e$$

at impact energies between 2.5 keV and 10 MeV. The sensitivity of the cross-section of the process

$$H(1s) + H^-(1s^2) \rightarrow H(1s) + H(2p) + e$$

to the choice of bound and free H^- wave-function is examined, as is that of the process

$$H(1s) + H^-(1s^2) \rightarrow H(2p) + H(1s) + e$$

to the choice of free H^- wave-function. The electron loss cross-section $\sigma_{-1,0}$ is approximated by a sum rule, for the simplest choice of wave-function. The results are compared with those of Allison (Abstr. 3968 of 1959) for H^- electron loss in H_2. The energy distribution of ejected electrons at high impact energies is also given.

537.56

5279 DOUBLE CHARGE TRANSFER AND THE MOBILITY OF He^{2+} IONS IN HELIUM.
A.F.Ferguson and B.L.Moiseiwitsch.
Proc. Phys. Soc., Vol. 74, Pt 4, 457-62 (Oct. 1, 1959).

The interaction energies between a He^{2+} ion and a He atom are

calculated for a wide range of internuclear distances. These energies are used to determine the cross-section for double charge transfer between He^{4+} ions and He atoms as well as the diffusion cross-section and mobility of these ions in helium gas.

ELECTRIC DISCHARGES

537.52 : 621.387

5280 NOISE SPECTRA OF A PROBE IN A HOT-CATHODE DISCHARGE. C.Singh.
Proc. Phys. Soc., Vol. 74, Pt 1, 42-7 (July 1, 1959).

Measurements have been made with a floating and a biased probe of the low-freqency noise which occurs in hot-cathode discharges through mercury vapour at low pressures. As previously reported by Cobine and Gallagher (Abstr. 1534 of 1947), and Martin and Woods (Abstr. 5177 of 1952), the spectrum is continuous but there are no superimposed peaks of oscillation. The spectra agree with that of the tube noise in their general shape. It has been shown that the primary electrons from the cathode are not essential for the noise to be recorded from the probe.

537.52

5281 THE SEPARATION OF BINARY MIXTURES OF INERT GASES IN A STEADY CURRENT DISCHARGE.
N.A.Matveeva.
Izv. Akad. Nauk SSSR, Ser fiz., Vol. 23, No. 8, 1021-5 (1959). In Russian.

An electrical discharge in a binary mixture of gases causes separation of the components. This might be explained either as a movement of neutral atoms or as ionic migration. The apparatus described leads to the acceptance of the latter explanation. The influence of pressure and relative concentration is studied. The phenomenon may find limited use in gas purification or in refined analysis. A.E.I. Research Laboratory

537.52

5282 THE PROBLEM OF ANOMALOUS DISCHARGES AT HIGH D.C. VOLTAGES. N.B.Bogdanova and V.I.Popkov.
Dokl. Akad. Nauk SSSR, Vol. 129, No. 2, 314-17 (Nov. 11, 1959). In Russian.

It has been known that long air gaps with weakly inhomogeneous fields (e.g. the clearance between the h.v. shield of a d.c. source and the building wall) may be subject to irregular breakdown when the applied voltage is positive; the mean breakdown voltage gradient may be as low as 2.25 kV/cm which is considerably less than for gaps with less uniform fields. This phenomenon was investigated and confirmed experimentally on a plane–plane type of gap with a small rod attached to the h.v. electrode to vary the degree of uniformity of the field. By analogy with the processes taking place in a short gap and using the results of conducted radio interference measurements, it is concluded that the absence of a positive space charge in the gap at voltages below that at which regular corona sets in produces favourable conditions for the formation and development of streamers which may lead to an early breakdown.
E.M.Dembinski

537.52

5283 POSITIVE COLUMN OF A DISCHARGE IN DIFFUSION CONDITIONS. V.M.Zakharova, Yu.M.Kagan and V.I.Perel'.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 23, No. 8, 999-1003 (1959). In Russian.

On the basis of Frost's theory (Abstr. 4498 of 1957), a number of relations are obtained, suitable for comparison with the results of experiments. This comparison has been carried out for the positive column in Hg, A and K discharges. The agreement between theory and experiment is fair in all cases when the conditions of operation are of the diffusion type. F.Lachman

537.52

5284 LIGHT FROM THE CORONA DISCHARGE. R.W.E.Cook.
Nature (London), Vol. 184, 1055 (Oct. 3, 1959).

Briefly describes photomultiplier – c.r.o. observations on the light from positive and negative point impulse corona. The overall circuit rise time was not more than 10^{-8} sec. J.D.Craggs

537.52

5285 THE EARLY STAGES OF SPARK CHANNEL EXPANSION. J.M.Somerville and J.F.Williams.
Proc. Phys. Soc., Vol. 74, Pt 3, 309-15 (Sept., 1959).

Investigations are reported, based on a study of the mark left on the anode by a spark in air, which give information about the distribution of conductivity across a spark channel during the first microsecond after initiation. These indicate (a) that the spark channel becomes "hollow" after a few tens of millimicroseconds, with maximum conductivity towards its periphery, (b) that the diameters of the conducting channel, of the mark left on the anode, and of the shock front generated by the spark are approximately coincident for about one hundred millimicroseconds, and (c) that the energy which generated the shock is all supplied to the channel during the first few tens of millimicroseconds.

537.52 : 537.7 : 621.317.726

5286 A SPARK GAP WITH CROSSED CYLINDER ELECTRODES FOR VOLTAGE MEASUREMENTS.
L.Medina.
Austral. J. appl. Sci., Vol 10, No. 4, 404-17 (Dec., 1959).

A crossed cylinder spark gap has been shown to have considerable advantages both from a constructional and operational point of view. In particular, one calibration suffices for a.c., d.c., and impulse voltages. A convenient and accurate method for measuring the peak voltage ratio of a testing transformer is described.

537.52

5287 TEMPERATURE MEASUREMENTS IN SPARK DISCHARGES MADE WITH TIME RESOLVED SPECTROSCOPY. H.Spith and H.Krempl.
Z. angew. Phys., Vol. 12, No. 1, 8-16 (Jan., 1960). In German.

Gives a detailed discussion of spectroscopic methods for the measurement of electron and excitation temperatures in spark discharges, and describes experiments made with condensed discharges. A 0.1μF, 10 kV capacitor was used. J.D.Craggs

537.52

5288 DEVELOPMENT OF SPACE CHARGE AND GROWTH OF IONIZATION IN THE TRANSIENT TOWNSEND DISCHARGE. Y.Miyoshi.
Phys. Rev., Vol. 117, No. 2, 335-65 (Jan. 15, 1960).

By using the general formulae derived from the analysis in a previous paper (Abstr. 419 of 1957), calculations are made of the development of electronic and ionic space charges, the growth of space-charge-distorted field, the buildup of current, and the gain in ionization integral due to the field distortion in the transient Townsend discharge. On the basis of these data, two types of Townsend-mechanism spark breakdown are also discussed.

537.52

5289 ON THE CHARACTERISTICS OF CYLINDRICAL ARCS. H.Maecker.
Z. Phys., Vol. 157, No. 1, 1-29 (1959). In German.

A detailed analytical study of energy balance, current–voltage characteristics etc. The usual basic equations are given and then treated at some length. Temperature–conductivity and current–voltage relations are calculated for certain simple cases by exact and approximate methods which agree closely. A comparison with experimental data is drawn. J.D.Craggs

537.52

5290 THE EFFECT OF CATHODE EROSION ON THE ENERGY BALANCE OF A HIGH CURRENT CARBON ARC. E.Hinrichs and R.Wienecke.
Z. Phys., Vol. 156, No. 4, 592-7 (1959). In German.

Gives data on cathode wear as a function of current (max. about 800 A) and on axial variations of potential for 200 and 800 A arcs, 4 cm in length. Radial potential variations were studied with a moving probe traversed rapidly through the discharge.
J.D.Craggs

537.52

5291 THE BUILD-UP OF SUCCESSIVE STANDING STRIATIONS IN GLOW DISCHARGES.
S.Pfau and A.Rutscher.
Naturwissenschaften, Vol. 46, No. 23, 646 (1959). In German.

Describes observations on striations in hydrogen (1 mm pressure) in a long tube. Current, and consequent voltage, changes are also briefly discussed. J.D.Craggs

537.52

5292 MICROPHYSICAL PROCESSES CAUSING FAST STRIATION WAVES IN NEON GLOW DISCHARGES.
L.Pekárak and M.Novák.
Czech. J. Phys., Vol. 9, No. 5, 641-51 (1959). In German.

Velocities and relaxation times for moving striations were measured (currents of a few milliamps, pressure 1.9 mm Hg). Layer formation processes (the effect of diffusion, etc.) are discussed and Ne_2^+ ions are invoked. J.D.Craggs

537.52 : 551.5

5293 INVESTIGATION OF AURORAL AFTERGLOW AND ITS PREPARATORY STAGES. III. THE DECAY OF THE AURORAL AFTERGLOW. H.H.Brömer.
Z. Phys., Vol. 158, No. 2, 133-41 (1960). In German.

For Pt II, see Abstr. 2346-7 (1960). The intensity decay of the negative bands of N_2^+ and of the first positive bands of N_2 has been measured. A possible explanation for the decay curves of the former is proposed: the intensity decay at the beginning of the afterglow at high ionic densities is determined by the recombination of N_2^+ with electrons; later, the ambipolar diffusion of the charge carriers to the wall introduces the time dependence. A value of the ambipolar diffusion coefficient in nitrogen, derived from measurements, is given by $D_a \cdot p \cong 124\ cm^2\ sec^{-1}$ torr. The temperature of the charge carriers is estimated to be 313°K. The intensity decay of the first positive group in the afterglow seems mainly to be due to the diffusion of metastable particles to the wall.

537.52

5294 MICROWAVE STUDY OF AFTERGLOW DISCHARGE IN WATER VAPOR. S.Takeda and A.A.Dougal.
J. appl. Phys., Vol. 31, No. 2, 412-16 (Feb., 1960).

Results of a microwave investigation of decaying plasmas produced in water vapour are reported. Electron loss processes prevailing in these decaying water vapour plasmas were interpreted. In the electron density range from 10^{10} to 10^9 per cm^3, electron–ion recombination prevails as the dominant electron loss process with a coefficient of 10^{-6} to $10^{-5}\ cm^3/sec$. For vapour pressures up to 7.0 mm Hg, electron attachment to vapour molecules or their derivatives was too small to be detectable, i.e., an attachment probability less than 10^{-7}. The electron collision probability for momentum transfer collisions with water vapour molecules was measured to be $2300 \pm 500\ cm^{-1}\ mm\ Hg^{-1}$ for electrons near thermal energies at room temperature. The collision probability steeply decreases with increasing electron energy in the low energy range. An interpretation of the de-ionization processes in T.R. tubes filled with admixtures of water vapour and noble gases is given.

537.52

5295 MICROWAVE METHOD OF INVESTIGATING THE AFTERGLOWS OF PULSED GASEOUS DISCHARGES.
M.C.Sexton, J.J.Lennon and M.J.Mulcahy.
Brit. J. appl. Phys., Vol. 10, No. 8, 356-9 (Aug., 1959).

An apparatus suitable for recording the decrease of electron density in the afterglows of pulsed microwave discharges at 3 and 10 cm wavelengths is described. This employs the well-known method of measuring the frequency shift induced in a resonant cavity by the presence of free electrons, but a new method of detecting the resonant reflections using a hybrid T-junction is employed. Modifications to the frequency-modulation method of probing the afterglow, which are particularly suitable for the analysis of slowly decaying plasmas, are described. An account is also given of a vacuum system suitable for handling high purity gases.

537.52

5296 INVESTIGATION OF SELF-SUSTAINED ULTRA-HIGH-FREQUENCY PULSE DISCHARGES IN AIR AND THE MECHANISM OF THEIR INITIATION.
P.S.Bulkin, G.S.Solntsev and V.N.Ponomarev.
Izv. Akad. Nauk SSSR, Ser fiz., Vol. 23, No. 8, 941-7 (1959).
In Russian.

The light radiation and electron density changes accompanying high frequency discharges are studied with a view to determining the mechanism of the discharges and the conditions under which they become self-sustaining. Three distinct stages in the growth of a discharge are described. Self-sustained discharges can be built up either by a single impulse or by a short series of periodic impulses. A.E.I. Research Laboratory

537.52

5297 SOME RESULTS ON THE FORMATION OF HIGH-FREQUENCY DISCHARGE AT LOW PRESSURE.
G.N.Zastenker and G.S.Solntsev.
Izv. Akad. Nauk SSSR, Ser fiz., Vol. 23, No. 8, 934-40 (1959).
In Russian.

Describes an experimental investigation of the process of formation of the discharge in argon with field frequency of 3.3 Mc/s at pressures from 0.4 to 15 mm Hg. The high-frequency potential of constant amplitude was superposed on the discharge gap, and the state of gas was observed at subsequent times using a photomultiplier. The formation time of the discharge was found to be from 300 μ sec to 10 μ sec (with the change of overvoltage from 5 to 60%), and its dependence on pressure was analogous to the dependence of breakdown potential on pressure. Theoretical calculations of formation time of the initial state of the discharge agree with experimental results for pressures above 9 mm Hg.
J.M.Zarzycki

537.52

5298 MEASUREMENT OF ELECTRIC FIELDS IN A HIGH-FREQUENCY DISCHARGE AT LOW PRESSURE BY MEANS OF AN ELECTRON BEAM.
G.S.Solntsev, A.G.Porokhin and N.M.Chistyakova.
Izv. Akad. Nauk SSSR, Ser fiz., Vol. 23, No. 8, 1026-30 (1959).
In Russian.

The method enables measurement of both the h.f. field and the space-charge field in different regions of the discharge gap. Experimental results are given for the distribution of electric fields, the potential and space charge in a h.f. discharge in argon at 10^{-2} mm Hg pressure measured at different instantaneous values of the period of the h.f. field. Z.Krasucki

537.52

5299 CONTRIBUTION TO THE THEORY OF THE HIGH FREQUENCY TORCH DISCHARGE.
R.Grigorovici and G.Cristescu.
Rev. de Physique (Bucarest), Vol. 4, No. 2, 153-76 (1959).
In German.

A discussion of heat losses from the torch discharge (frequency 10-100 Mc/s) on the basis of investigations on arcs made in recent years by Koppelmann, Mannkopff, King and others. The variation of thermal conductivity with temperature (up to about 10 000°K) the energy balance relation, and discharge temperatures are discussed. Electron temperatures vary up to about 40 000°K. J.D.Craggs

537.52

5300 ROLE OF MOLECULAR IONS, METASTABLE MOLECULES, AND RESONANCE RADIATION IN THE BREAKDOWN OF RARE GASES. A.V.Phelps.
Phys. Rev., Vol. 117, No. 3, 619-32 (Feb. 1, 1960).

Theoretical calculations are made of the rates of arrival of atomic and molecular ions, of atomic and molecular metastables, and of nonresonance and resonance radiation at the cathode of parallel plane electrodes during the buildup of current preceding the breakdown of a rare gas. The electron density is assumed to increase exponentially with time and distance. Previous analyses are extended to obtain the particle currents of molecular ions and of mestable atoms and molecules at the cathode. The Holstein–Biberman formulation of the transport equation for the density of atoms in the resonance state is solved numerically to find the fraction of resonance photons arriving at the cathode. The fraction of resonance radiation reaching the cathode varies with the growth constant of the electron current in very nearly the same manner as for delayed photons and varies much less rapidly with electrode spacing and gas desnity than for the case of diffusing particles. The theory is applied to the calculation of the growth constant as a function of applied voltage for helium at 100 mm Hg pressure and a 1 cm gap. The growth of current is found to be controlled by the rates of arrival of molecular metastables, molecular ions, and resonance radiation at the cathode.

537.52 : 539.2 : 535.33

STUDY IN THE INFRARED OF CERTAIN SOLIDS CONDENSED AFTER A DISCHARGE IN THE GASEOUS PHASE. See Abstr. 4420

537.52 : 539.2 : 535.33

SPECTROSCOPIC STUDY OF THE PRODUCTS OF ELECTRIC DISCHARGE IN NITROGEN CONDENSED TO THE SOLID STATE AT VERY LOW TEMPERATURE; TESTS IN FAVOUR OF THE EXISTENCE OF TRIATOMIC NITROGEN IN THE SOLID.
See Abstr. 4419

PLASMA

537.56

5301 ON THE MECHANISM OF THE PINCH EFFECT. T.Gotō, M.Sato and T.Uchida.

Nuovo Cimento, Vol. 14, No. 5, 1065-75 (Dec. 1, 1959).

Phenomenological analysis of the fast pinch effect is presented and compared with some existing experimental data. It is argued that several results consistent with experiments can be derived from a general basic picture of the fast contracting process, independent of its detailed mechanism. To establish a consistent model of the pinch mechanism,it is therefore necessary to get more detailed experimental information about the dynamical behaviour of the plasma column under various initial conditions. Dimensional considerations are added in the appendix.

537.56

5302 ON THE MECHANISM OF CURRENT CONSTRICTION IN HIGH-CURRENT GAS DISCHARGES. M.A.Leontovich and S.M.Osovets.

J.nuclear Energy, Vol. 4, No. 2, 209-12 (Feb., 1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 3, 81 (1956).

A theory is given of the mechanism of the current constriction caused by electrodynamic forces.

537.56 : 621.387

5303 THE CIRCUIT DYNAMICS OF PLASMA. B.S.Liley.

Proc. Instn Elect. Engrs, Paper 2899 [Convention on Thermonuclear Processes], publ. April, 1959 (Vol. 106A, Suppl. No. 2, 158-65, 182-5).

Republication, with discussion, of the paper abstracted as Abstr. 4737 (1959).

537.56 : 539.17 : 621.039 : 621.387

5304 PHYSICAL MEASUREMENTS ON HEAVY-CURRENT DISCHARGES. R.M.Payne and S.Kaufman.

Proc. Instn Elect. Engrs, Paper 2900 [Convention on Thermonuclear Processes], publ. April, 1959 (Vol. 106A, Suppl. No. 2, 36-42, 43-6).

Republication, with discussion, of the paper abstracted in Abstr. 4652 (1959).

537.56 : 621.387 : 621.039

5305 CHOICE OF MATERIALS AND PROBLEMS OF DESIGN OF HEAVY-CURRENT TOROIDAL DISCHARGE TUBES. A.E.Robson and R.Hancox.

Proc. Instn Elect. Engrs, Paper 2948 [Convention on Thermonuclear Processes], publ. April, 1959 (Vol. 106A, Suppl. No. 2, 47-55, 82-4).

Republication, with discussion, of the paper abstracted in Abstr. 4653 (1959).

537.56

5306 INVESTIGATION OF HIGH CURRENT PULSE DISCHARGES IN CONICAL CHAMBERS. N.A.Borzunov, D.V.Orlinskii and M.Osovets.

Zh. eksper. teor. Fiz., Vol. 36, No. 3, 717-26 (1959). In Russian.

Some general considerations are presented concerning the possibility of formation of a cumulative jet upon contraction of a conical plasma envelope. Preliminary results of some experiments performed with so-called single and double conical systems are presented and also the results of some other measurements.

537.56 : 621.039 : 621.387

5307 RAPID COMPRESSION OF A PLASMA WITH AZIMUTHAL CURRENT. G.B.F.Niblett.

Proc. Instn Elect. Engrs, Paper 2882 [Convention on Thermonuclear Processes], publ. April, 1959 (Vol. 106A, Suppl. No. 2, 152-7, 182-5, 1959).

Republication, with discussion, of the paper abstracted as Abstr. 4736 (1959).

537.56

5308 THE LOW PRESSURE PLANE SYMMETRIC DISCHARGE. E.R.Harrison and W.B.Thompson.

Proc. Phys. Soc., Vol. 74, Pt 2, 145-52 (Aug., 1959).

It is shown that the low-pressure plane symmetric plasma equation, using collision-free model of Tonks and Langmuir, can be solved analytically. Simple expressions are obtained for the mean velocity and the mean square velocity of the ions, and for the wall potential with respect to the plasma. The conditions for the formation of a stable plasma-sheath boundary are briefly examined and a general criterion is obtained without considering any specific mechanism of ion transport. No assumptions are made regarding the energy distribution of the ions, and the result is therefore a refinement on Bohm's original criterion which was derived by assuming a monoenergetic ion flux. With the aid of the criterion developed in the present treatment conclusions are then drawn in the case of the collision-free model regarding conditions applying at the plasma boundary. The experimental results are found to be consistent with these theoretical conditions.

537.56

5309 COOPERATIVE PHENOMENA AND DIFFUSION OF A PLASMA IN A TRANSVERSE MAGNETIC FIELD. I. L.Biermann and D.Pfirsch.

Z. Naturforsch., Vol. 15a, No. 1, 10-12 (Jan., 1960). In German

The possibility is discussed that, under certain conditions, local fluctuations of charge density may be excited in an inhomogeneous plasma. Their maximal amplitudes are estimated and the influence of these instabilities on the confinement of a plasma by a magnetic field is investigated.

537.56

5310 COOPERATIVE PHENOMENA AND DIFFUSION OF A PLASMA IN A TRANSVERSE MAGNETIC FIELD.II. D.Pfirsch and L.Biermann.

Z. Naturforsch., Vol. 15a, No. 1, 14-18 (Jan., 1960). In German.

Using two examples of inhomogeneous plasmas the occurrence of microscopic instabilities is investigated. It is shown that an inhomogeneous one-component plasma with diffusion but without a magnetic field is stable in the limiting case of linearized theory and that in a similar plasma without diffusion,which is confined by a magnetic field, an instability of apparently fairly general character exists, but its range is not yet known.

537.56

5311 THE POSSIBILITY OF OBSERVING "OVER-THERMAL" ELECTRIC-FIELD FLUCTUATIONS IN PLASMAS BY MEANS OF SPECTROSCOPIC MEASUREMENTS. H.Wulff.

Z. Naturforsch., Vol. 15, No. 1, 13 (Jan., 1960). In German.

The possibility is investigated of detecting these fluctuations by Stark-effect broadening. It is concluded that in conventional plasmas the influence of these fluctuations is much too small to be detectable by this effect.

537.56

5312 AN INVESTIGATION OF A HIGH-CURRENT GAS DISCHARGE IN A LONGITUDINAL MAGNETIC FIELD. A.L.Bezbatchenko, I.N.Golovin, D.P.Ivanov, V.D.Kirillov, and N.A.Yavlinsky.

J. nuclear Energy, Vol. 5, No. 1, 71-85 (1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 5, 26 (1956).

A gas discharge in deuterium has been investigated at currents up to 700 kA in a longitudinal magnetic field of up to 12 000 Oe. The influence of the field on the development of the discharge column was detected. Estimates are given of the plasma conductivity and the ionization coefficient.

537.56

5313 ON THE STABILITY OF A CYLINDRICAL GASEOUS CONDUCTOR IN A MAGNETIC FIELD. V.D.Shrafranov.

J. nuclear Energy, Vol. 5, No. 1, 86-91 (1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 5, 38 (1956).

Hydrodynamical conditions are obtained for the stability of an ideal cylindrical gaseous conductor in an external magnetic field.

537.56

5314 DRIFT OF A CHARGED PARTICLE IN A MAGNETIC FIELD OF CONSTANT GRADIENT. P.W.Seymour.

Austral. J. Phys., Vol. 12, No. 4, 309-14 (Dec., 1959).

An exact solution is obtained for the drift velocity. The method easily yields as approximations Alfven's result (1940 and 1950) and the case of circular orbit, and includes the case of zero mean field, for which perturbation methods are inappropriate.

537.56

5315 THE MOTION OF CHARGED PARTICLES IN A ROTATING PLASMA. B.Bonnevier and B.Lehnert.

Ark. Fys., Vol. 16, Paper 22, 231-6 (1959).

The confinement of charged particles by magnetic mirrors in a rotating plasma is considered. The forbidden regions of a charged particle in crossed electric and magnetic fields are discussed with

special attention to the centrifugal and Coriolis forces. It is found that, under certain conditions, particles will move almost along the magnetic field lines and will be completely reflected at the mirrors by means of the centrifugal force. A high reflection power is obtained by fields with large radial extensions such as that generated by a circular current loop.

537.56 : 539.12

5316 ELECTROMAGNETIC RADIATION FROM ELECTRONS ROTATING IN AN IONIZED MEDIUM UNDER THE ACTION OF A UNIFORM MAGNETIC FIELD. R.Q.Twiss and J.A.Roberts.
Austral. J. Phys., Vol. 11, No. 3, 424-46 (Sept., 1958).

A theory is given for the radiation from a fast electron rotating, under the action of an external magnetic field, in an ionized plasma. It is shown that, although the radiation is emitted predominantly in the extraordinary mode, the ordinary mode is also weakly excited, even in the limiting case in which the density of the background plasma is vanishingly small. At the harmonics of the gyro frequency of the fast electron the power radiated in the ordinary mode is a few per cent of that radiated in the extraordinary mode. This ratio is independent of v_0, the velocity of the fast electron, as long as v_0 is sufficiently small compared with c, the velocity of light. However, at the fundamental gyro frequency the power radiated in the ordinary mode is lower by a factor $\simeq 10^{-2}(v_0/c)^4$ than that radiated in the extraordinary mode and indeed is significantly smaller than that radiated, in either mode, at the third harmonic. The gyro theory of the non-thermal radiation from the sun is discussed in the light of these results and it is argued that this mechanism cannot explain the phenomena associated with the bursts of spectral types II and III. However, it is conceivable that the radiation on spectral type I may be of gyro origin, though even in this case there are serious objections to this explanation.

537.56

5317 HIGH-ENERGY RADIATION FROM PULSED DISCHARGES. L.A.Artsimovich, A.M.Andrianov, E.I.Dobrokhotov, S.Yu.Lukyanov, I.M.Podgornyi, V.I.Sinitsyn and N.V.Filippov.
J. nuclear Energy, Vol. 4, No. 2, 213-15 (Feb., 1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 3, 84 (1956).

Neutron radiation has been detected from pulsed discharges in deuterium, and hard X-radiation from similar discharges in various light gases. The results are discussed.

537.56

5318 SPECTROSCOPIC STUDIES OF A HIGH-POWER PULSED DISCHARGE IN HYDROGEN. S.Yu.Lukyanov and V.I.Sinitsyn.
J nuclear Energy, Vol. 4, No. 2, 216-23 (Feb., 1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 3, 88 (1956).

Spectroscopic methods have been used to investigate the properties of a high-power pulsed discharge in a gas. It is shown that in the initial stage of the process, associated with the convergence of the discharge towards the axis of the chamber, the propagation velocity of the luminous edges attains $6\text{-}8 \times 10^8$ cm sec^{-1}. The number of ionized atoms is estimated. Experiments are described in which the luminescence of the pulsed-discharge plasma was investigated. Spectral line intensities of the hydrogen plasmas are reported.

537.56

5319 EXPERIMENTAL INVESTIGATION OF A HIGH-ENERGY DENSITY, HIGH-PRESSURE ARC PLASMA. E.A.Martin.
J. appl. Phys., Vol. 31, No. 2, 255-67 (Feb., 1960).

The underwater spark is utilized to study the fundamental parameters of a plasma at 30 000°K and 10 000 atm pressure. The 25 kV spark is obtained by underwater discharge of capacitors having a stored energy of 1800 joules, the inertia of the water providing the confinement necessary to develop high pressures. Phenomena relating to the initiating wire (exploded wire) are discussed. Kerr cell photographs show that spherical structures are formed around both electrodes under certain conditions. A possible explanation is postulated. A detailed energy balance and particle balance are carried out. The results show that the plasma has great capability to store energy in dissociation, excitation, and ionization without a corresponding increase in temperature. The plasma is 30% ionized and the total particle density is about 2×10^{27} per cubic metre. At this density the plasma radiates a blackbody spectrum. Pressures are obtained by calculation based on the rate of spark channel expansion and the shock properties of water. The plasma is found to have an internal pressure of the same order of magnitude as the external pressure because of interparticle Coulomb forces. Plasma conductivity calculated from equations of Gvosdover and Spitzer and Harm agree very well with the experimental value. The study is basically experimental, with the emphasis in interpretation being placed on reliability of the conclusions rather than on refined accuracy.

537.56

5320 AN INVESTIGATION OF HIGH-CURRENT PULSED DISCHARGES. L.A.Artsimovich, A.M.Andrianov, O.A.Bazilevskaya, Yu.G.Prokhorov and N.V.Filippov.
J. nuclear Energy, Vol. 4, No. 2, 203-8 (Feb., 1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 3, 76 (1956).

High-power pulsed discharges with a high rate of current increase have been investigated experimentally. The technique is briefly outlined, and the pulsations of the plasma filament are described.

537.56

5321 MICROWAVE DETERMINATION OF PLASMA DENSITY PROFILES. C.B.Wharton and D.M.Slager.
J. appl. Phys., Vol. 31, No. 2, 428-30 (Feb., 1960).

A method for the rapid determination of the average electron density and of the spatial electron density distribution in plasmas is presented. The technique employed permits time-resolved measurements over a wide range of electron densities, introducing little or no perturbation into the gaseous discharge. The quantities measured by the described techniques have been correlated previously with other plasma measurements and show reasonably good agreement.

537.56

5322 PLASMA CONTAINMENT BY R.F. AND D.C. FIELD COMBINATIONS. D.G.Dow and R.C.Knechtli.
J. Electronics and Control, Vol. 7, No. 4, 316-43 (Oct., 1959).

An investigation has been made concerning the use of radio frequency fields for the containment of hot, dense plasmas, such as those needed for controlled thermonuclear fusion. Because high losses due to skin effect are associated with r.f. fields, they will be used at the lowest possible frequency, and only where they constitute a useful supplement to the cheaper d.c. fields. Such r.f. fields are to be useful for reducing the plasma leakage present in most d.c. confinement systems, and to prevent some of the instabilities inherent to d.c. systems. One particular combination of d.c. and r.f. fields has been analysed in detail. It consists of a homogeneous axial d.c. magnetic field (or a d.c. mirror field) containing a plasma column against radial diffusion; the ends of the column are "sealed" by means of r.f. fields. By using the proper polarization of the r.f. fields, it is shown that appreciable plasma pressures can be contained, using r.f. fields of frequencies as low as a few megacycles. By using r.f. powers of the order of a few kilowatts, it is expected to be feasible to contain plasmas of a density exceeding 10^{14} charges/cm^3 at temperatures exceeding 10 eV.

537.56

5323 THE RADIAL OSCILLATIONS AND STABILITY OF CYLINDRICAL PLASMA. R.Pinte and R.Simon.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 45, No. 6, 595-610 (1959). In French.

Considers a homogeneous cylindrical, completely ionized plasma in equilibrium under the action of its own gravity and in a longitudinal uniform magnetic field. The vacuum surrounding the plasma is assumed to be pervaded by a longitudinal uniform magnetic field and by a toroidal magnetic field caused by a sheet current flowing on the surface of the plasma. Assuming the classical hypothesis of magnetohydrodynamics (scalar pressure, infinite electrical conductivity, adiabatic changes), the dynamical stability of this equilibrium is discussed with respect to infinitely small radial perturbations. Application to the pinch effect is obtained by neglecting gravitation in the general results.

537.56

5324 THE PRODUCTION OF STABLE HIGH FREQUENCY PLASMOIDS AT THE PLASMA RESONANT FREQUENCY. R.Geller.
C.R. Acad. Sci. (Paris), Vol. 249, No. 25, 2749-51 (Dec. 21, 1959). In French.

High frequency plasmoids are produced in various shapes of containing vessel, and measurements made on the electron density, n, and electron temperature, using single and double probes. It is found that at electron densities of the order 10^7 cm^{-3}, the density adjusts itself to maintain resonance between the applied field and the plasma frequency $\omega_p = (4\pi ne^2/m)^{\frac{1}{2}}$. A.H.Gabriel

537.56

5325 EXCITATION OF HYDROMAGNETIC WAVES IN A PLASMA BY A MOVING CHARGE.

P.Ya.Damburg and V.Ya.Kravchenko.
Latv. PSR Zinat. Akad. Vestis, No. 7 (144), 87-92 (1959). In Russian.

A collision-free plasma in a uniform magnetic field is studied theoretically using an approximation where pressure transport is neglected. The loss of energy by a particle moving in a plane perpendicular to the field is calculated. If the particle's speed exceeds the Alfvén speed, the mechanism of energy loss resembles Cherenkov radiation. O.Penrose

537.56 : 538.3

STUDY OF ALFVÉN-WAVE PROPERTIES IN A PLASMA.
See Abstr. 3843

537.56 : 539.17 : 621.039 : 621.387

RAPIDLY HEATING PLASMAS BY SHOCK COMPRESSION.
See Abstr. 4155

ELECTRON EMISSION
ELECTRON BEAMS

537.533 : 621.385.833

5326 DENSE ELECTRON BEAMS. B.Meltzer.
Brit. J. appl. Phys., Vol. 10, No. 9, 391-7 (Sept., 1959).

The industrial context of electron beam design is sketched. The theoretical assumptions of classical trajectory behaviour and laminarity are discussed. Langmuir's diode analyses, Pierce's design method and Brillouin's magnetic collimation are described, as well as recent studies of the Pierce–Cauchy problem and self-magnetic effects in simple beams. Summaries are given of the conservation principles of beam dynamics, use of the action function in analysis and design, the position as regards computation, and some recent progress.

537.533

5327 CHANGE OF THE WORK FUNCTION OF AN ELECTRON ESCAPING FROM METAL, DUE TO AN ADSORBED FILM OF BaO MOLECULES. N.D.Morgulis.
Fiz. tverdogo Tela, Vol. 1, No. 7, 1125-32 (July, 1959). In Russian.

The following problems were investigated experimentally: (1) temperature dependence of work function, (2) effect of the nature of the metal substrate (chemical affinity and work function), and (3) characteristics of the mixed (BaO + Ba and BaO + CsCl) monomolecular films on metals. An attempt was made at separating in the system BaO - Ni the exchange part of the work function change from that related to the effect due to the dipole moment of the BaO molecule. F.Lachman

537.533 : 621.385.032.213.13

5328 CATHODE WORK FUNCTION, SPARKING POTENTIALS AND SECONDARY IONIZATION COEFFICIENTS FOR OXIDE-COATED CATHODES IN HYDROGEN.
D.E.Davies and B.J.Hopkins.
Brit. J. appl. Phys., Vol. 10, No. 11, 498-501 (Nov., 1959).

The Kelvin vibrating electrode technique has been applied to measure the contact potential difference between oxide-coated cathodes and a gold reference surface in the presence of hydrogen. Special high vacuum (Alpert) techniques were used to ensure high gas purity. By the use of both calcium oxide and barium oxide cathodes, in various states of activation, it was possible to obtain a range of work function from 1·4 to 3·6 eV. Paschen curves were plotted for each of these oxide cathodes at room temperature, and minimum sparking potentials and secondary ionization coefficients were determined. A linear relation was found between the cathode work function and the minimum sparking potential. The slope of this line indicated that a 1 eV change in work function corresponded to a change of 55 V in the minimum sparking potential. The slope of the line was confirmed by independent work function measurements using the graph of the Richardson thermionic equation. The curves (ω/α)versus(E/p) showed a rapid increase in ω/α with decreasing values of E/p at E/p<100 V/cm mm of mercury.

537.533 : 621.385.032.213.13

5329 INFLUENCE OF THE CATHODE WORK FUNCTION ON THE SPARKING POTENTIAL IN HYDROGEN.
D.E.Davies and R.K.Fitch.
Brit. J. appl. Phys., Vol. 10, No. 11, 502-5 (Nov., 1959).

The Kelvin or vibrating electrode method of measuring contact potential differences has been used to follow changes in work function of evaporated metallic films in a parallel plate electrode system in hydrogen at about 10 mm of mercury pressure. A reduction in cathode work function of the order of 0.3 eV was effected by passing a current of 10^{-4} A for 10 s. After about 30 min the cathode work function returned to its original value. Similar treatment caused a reduction in the sparking potential of 30 V, which also returned to its original pre-discharge value in times of the order of 30 min. This, together with other experimental data, is consistent with the fact that positive ions from the discharge current remained on the cathode surface for periods up to 30 min after the current was switched off. It has been possible to demonstrate that, while these positive ions are being neutralized, there is a relationship between the work function of a cathode and its sparking potential in hydrogen.

537.533

5330 ELECTRON EMISSION FROM PURE METAL SURFACES AT ROOM TEMPERATURE. M.V.Sinel'nikov.
Radiotekhnika i Elektronika, Vol. 3, No. 12, 1523-4 (1958). In Russian.

Electron emission from the surfaces of certain metals at room temperature without the action of external radiation or an electric field is investigated. This emission is explained as due to structural changes or chemical reactions in the surface layer or to the existence of supplementary electron surface states. The investigation was conducted to ascertain whether emission can occur from pure metals or only in the presence of impurities. Magnesium, aluminium and copper were examined. Currents of the order of 10^{-14} A, continuing for several days, were obtained from the magnesium and aluminium but no current was obtained from the copper. The preparation of the surfaces is described. [English summary: PB 141106T-11 obtainable from Office of Technical Services, U.S. Department of Commerce, Washington D.C., U.S.A.]. R.C.Glass

537.533

5331 THE ROLE OF FIELD EMISSION IN THE MAINTENANCE OF THE ELECTRICAL DISCHARGE AT THE CATHODE IN A GAS AT LOW PRESSURE. H.Doucet.
C. R. Acad. Sci. (Paris), Vol. 250, No. 6, 1007-9 (Feb. 8, 1960). In French.

A previous theory of the mechanism of low pressure gas discharges involves secondary emission from the cathode due to positive ion bombardment. It is pointed out that this theory does not predict a narrow distribution of electron velocities, as observed experimentally, and that the magnitude of the secondary emission coefficient for the cathode material will seldom be large enough to explain the maintenance of the discharge. It is suggested that field emission takes place from the cathode due to strong local potential gradients induced by the approach of positive ions to the cathode. Calculations suggest that the potential gradient in a cylindrical discharge between parallel plates is insufficient to produce field emission with the experimental arrangement adopted, but that in a conical discharge the field is sufficient. Experimental evidence is produced to show that at low pressures the discharge may, in fact, be conical. C.H.B.Mee

537.533

5332 CURRENT FLUCTUATIONS IN THE OXIDE CATHODE. M.Chisholm and L.Jacob.
Nature (London), Vol. 184, 1058-9 (Oct. 3, 1959).

Reports observations of the conduction and emission currents from (Ba,Sr)O cathodes under the influence of the anode field. Slow, large-amplitude fluctuations were observed in both currents for certain anode voltages. A.H.W.Beck

537.533

5333 REVERSIBLE POISONING BY SULPHUR, OXYGEN AND OTHER GASES OF OXIDE-COATED CATHODES AT HIGH TEMPERATURES. N.A.Surplice.
Brit. J. appl. Phys., Vol. 10, No. 8, 359-63 (Aug., 1959).

A simple mass spectrometer has been used to select and study the behaviour of the negative ions of sulphur and oxygen emitted by oxide-coated cathodes on recovery from the poisoning of their electron emission by these agents over the temperature range

special attention to the centrifugal and Coriolis forces. It is found that, under certain conditions, particles will move almost along the magnetic field lines and will be completely reflected at the mirrors by means of the centrifugal force. A high reflection power is obtained by fields with large radial extensions such as that generated by a circular current loop.

537.56 : 539.12

5316 ELECTROMAGNETIC RADIATION FROM ELECTRONS ROTATING IN AN IONIZED MEDIUM UNDER THE ACTION OF A UNIFORM MAGNETIC FIELD. R.Q.Twiss and J.A.Roberts.
Austral. J. Phys., Vol. 11, No. 3, 424-46 (Sept., 1958).

A theory is given for the radiation from a fast electron rotating, under the action of an external magnetic field, in an ionized plasma. It is shown that, although the radiation is emitted predominantly in the extraordinary mode, the ordinary mode is also weakly excited, even in the limiting case in which the density of the background plasma is vanishingly small. At the harmonics of the gyro frequency of the fast electron the power radiated in the ordinary mode is a few per cent of that radiated in the extraordinary mode. This ratio is independent of v_0, the velocity of the fast electron, as long as v_0 is sufficiently small compared with c, the velocity of light. However, at the fundamental gyro frequency the power radiated in the ordinary mode is lower by a factor $\simeq 10^{-2}(v_0/c)^4$ than that radiated in the extraordinary mode and indeed is significantly smaller than that radiated, in either mode, at the third harmonic. The gyro theory of the non-thermal radiation from the sun is discussed in the light of these results and it is argued that this mechanism cannot explain the phenomena associated with the bursts of spectral types II and III. However, it is conceivable that the radiation on spectral type I may be of gyro origin, though even in this case there are serious objections to this explanation.

537.56

5317 HIGH-ENERGY RADIATION FROM PULSED DISCHARGES. L.A.Artsimovich, A.M.Andrianov, E.I.Dobrokhotov, S.Yu.Lukyanov, I.M.Podgornyi, V.I.Sinitsyn and N.V.Filippov.
J. nuclear Energy, Vol. 4, No. 2, 213-15 (Feb., 1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 3, 84 (1956).

Neutron radiation has been detected from pulsed discharges in deuterium, and hard X-radiation from similar discharges in various light gases. The results are discussed.

537.56

5318 SPECTROSCOPIC STUDIES OF A HIGH-POWER PULSED DISCHARGE IN HYDROGEN. S.Yu.Lukyanov and V.I.Sinitsyn.
J nuclear Energy, Vol. 4, No. 2, 216-23 (Feb., 1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 3, 88 (1956).

Spectroscopic methods have been used to investigate the properties of a high-power pulsed discharge in a gas. It is shown that in the initial stage of the process, associated with the convergence of the discharge towards the axis of the chamber, the propagation velocity of the luminous edges attains $6\text{-}8 \times 10^6$ cm sec^{-1}. The number of ionized atoms is estimated. Experiments are described in which the luminescence of the pulsed-discharge plasma was investigated. Spectral line intensities of the hydrogen plasmas are reported.

537.56

5319 EXPERIMENTAL INVESTIGATION OF A HIGH-ENERGY DENSITY, HIGH-PRESSURE ARC PLASMA. E.A.Martin.
J. appl. Phys., Vol. 31, No. 2, 255-67 (Feb., 1960).

The underwater spark is utilized to study the fundamental parameters of a plasma at 30 000°K and 10 000 atm pressure. The 25 kV spark is obtained by underwater discharge of capacitors having a stored energy of 1800 joules, the inertia of the water providing the confinement necessary to develop high pressures. Phenomena relating to the initiating wire (exploded wire) are discussed. Kerr cell photographs show that spherical structures are formed around both electrodes under certain conditions. A possible explanation is postulated. A detailed energy balance and particle balance are carried out. The results show that the plasma has great capability to store energy in dissociation, excitation, and ionization without a corresponding increase in temperature. The plasma is 30% ionized and the total particle density is about 2×10^{27} per cubic metre. At this density the plasma radiates a blackbody spectrum. Pressures are obtained by calculation based on the rate of spark channel expansion and the shock properties of water. The plasma is found to have an internal pressure of the same order of magnitude as the external pressure because of interparticle Coulomb forces. Plasma conductivity calculated from equations of Gvosdover and Spitzer and Harm agree very well with the experimental value. The study is basically experimental, with the emphasis in interpretation being placed on reliability of the conclusions rather than on refined accuracy.

537.56

5320 AN INVESTIGATION OF HIGH-CURRENT PULSED DISCHARGES. L.A.Artsimovich, A.M.Andrianov, O.A.Bazilevskaya, Yu.G.Prokhorov and N.V.Filippov.
J. nuclear Energy, Vol. 4, No. 2, 203-8 (Feb., 1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 3, 76 (1956).

High-power pulsed discharges with a high rate of current increase have been investigated experimentally. The technique is briefly outlined, and the pulsations of the plasma filament are described.

537.56

5321 MICROWAVE DETERMINATION OF PLASMA DENSITY PROFILES. C.B.Wharton and D.M.Slager.
J. appl. Phys., Vol. 31, No. 2, 428-30 (Feb., 1960).

A method for the rapid determination of the average electron density and of the spatial electron density distribution in plasmas is presented. The technique employed permits time-resolved measurements over a wide range of electron densities, introducing little or no perturbation into the gaseous discharge. The quantities measured by the described techniques have been correlated previously with other plasma measurements and show reasonably good agreement.

537.56

5322 PLASMA CONTAINMENT BY R.F. AND D.C. FIELD COMBINATIONS. D.G.Dow and R.C.Knechtli.
J. Electronics and Control, Vol. 7, No. 4, 316-43 (Oct., 1959).

An investigation has been made concerning the use of radio frequency fields for the containment of hot, dense plasmas, such as those needed for controlled thermonuclear fusion. Because high losses due to skin effect are associated with r.f. fields, they will be used at the lowest possible frequency, and only where they constitute a useful supplement to the cheaper d.c. fields. Such r.f. fields are to be useful for reducing the plasma leakage present in most d.c. confinement systems, and to prevent some of the instabilities inherent to d.c. systems. One particular combination of d.c. and r.f. fields has been analysed in detail. It consists of a homogeneous axial d.c. magnetic field (or a d.c. mirror field) containing a plasma column against radial diffusion; the ends of the column are "sealed" by means of r.f. fields. By using the proper polarization of the r.f. fields, it is shown that appreciable plasma pressures can be contained, using r.f. fields of frequencies as low as a few megacycles. By using r.f. powers of the order of a few kilowatts, it is expected to be feasible to contain plasmas of a density exceeding 10^{14} charges/cm^3 at temperatures exceeding 10 eV.

537.56

5323 THE RADIAL OSCILLATIONS AND STABILITY OF CYLINDRICAL PLASMA. R.Pinte and R.Simon.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 45, No. 6, 595-610 (1959). In French.

Considers a homogeneous cylindrical, completely ionized plasma in equilibrium under the action of its own gravity and in a longitudinal uniform magnetic field. The vacuum surrounding the plasma is assumed to be pervaded by a longitudinal uniform magnetic field and by a toroidal magnetic field caused by a sheet current flowing on the surface of the plasma. Assuming the classical hypothesis of magnetohydrodynamics (scalar pressure, infinite electrical conductivity, adiabatic changes), the dynamical stability of this equilibrium is discussed with respect to infinitely small radial perturbations. Application to the pinch effect is obtained by neglecting gravitation in the general results.

537.56

5324 THE PRODUCTION OF STABLE HIGH FREQUENCY PLASMOIDS AT THE PLASMA RESONANT FREQUENCY. R.Geller.
C.R. Acad. Sci. (Paris), Vol. 249, No. 25, 2749-51 (Dec. 21, 1959). In French.

High frequency plasmoids are produced in various shapes of containing vessel, and measurements made on the electron density, n, and electron temperature, using single and double probes. It is found that at electron densities of the order 10^7 cm^{-3}, the density adjusts itself to maintain resonance between the applied field and the plasma frequency $\omega_0 = (4\pi ne^2/m)^{\frac{1}{2}}$. A.H.Gabriel

537.5e

5325 EXCITATION OF HYDROMAGNETIC WAVES IN A PLASMA BY A MOVING CHARGE.

P.Ya.Damburg and V.Ya.Kravchenko.
Latv. PSR Zinat. Akad. Vestis, No. 7 (144), 87-92 (1959). In Russian.

A collision-free plasma in a uniform magnetic field is studied theoretically using an approximation where pressure transport is neglected. The loss of energy by a particle moving in a plane perpendicular to the field is calculated. If the particle's speed exceeds the Alfvén speed, the mechanism of energy loss resembles Cherenkov radiation. O.Penrose

537.56 : 538.3

STUDY OF ALFVÉN-WAVE PROPERTIES IN A PLASMA.
See Abstr. 3843

537.56 : 539.17 : 621.039 : 621.387

RAPIDLY HEATING PLASMAS BY SHOCK COMPRESSION.
See Abstr. 4155

ELECTRON EMISSION
ELECTRON BEAMS

537.533 : 621.385.833

5326 DENSE ELECTRON BEAMS. B.Meltzer.

Brit. J. appl. Phys., Vol. 10, No. 9, 391-7 (Sept., 1959).

The industrial context of electron beam design is sketched. The theoretical assumptions of classical trajectory behaviour and laminarity are discussed. Langmuir's diode analyses, Pierce's design method and Brillouin's magnetic collimation are described, as well as recent studies of the Pierce–Cauchy problem and self-magnetic effects in simple beams. Summaries are given of the conservation principles of beam dynamics, use of the action function in analysis and design, the position as regards computation, and some recent progress.

537.533

5327 CHANGE OF THE WORK FUNCTION OF AN ELECTRON ESCAPING FROM METAL, DUE TO AN ADSORBED FILM OF BaO MOLECULES. N.D.Morgulis.

Fiz. tverdogo Tela, Vol. 1, No. 7, 1125-32 (July, 1959). In Russian.

The following problems were investigated experimentally: (1) temperature dependence of work function, (2) effect of the nature of the metal substrate (chemical affinity and work function), and (3) characteristics of the mixed (BaO + Ba and BaO + CsCl) monomolecular films on metals. An attempt was made at separating in the system BaO - Ni the exchange part of the work function change from that related to the effect due to the dipole moment of the BaO molecule. F.Lachman

537.533 : 621.385.032.213.13

5328 CATHODE WORK FUNCTION, SPARKING POTENTIALS AND SECONDARY IONIZATION COEFFICIENTS FOR OXIDE-COATED CATHODES IN HYDROGEN.

D.E.Davies and B.J.Hopkins.
Brit. J. appl. Phys., Vol. 10, No. 11, 498-501 (Nov., 1959).

The Kelvin vibrating electrode technique has been applied to measure the contact potential difference between oxide-coated cathodes and a gold reference surface in the presence of hydrogen. Special high vacuum (Alpert) techniques were used to ensure high gas purity. By the use of both calcium oxide and barium oxide cathodes, in various states of activation, it was possible to obtain a range of work function from 1·4 to 3·6 eV. Paschen curves were plotted for each of these oxide cathodes at room temperature, and minimum sparking potentials and secondary ionization coefficients were determined. A linear relation was found between the cathode work function and the minimum sparking potential. The slope of this line indicated that a 1 eV change in work function corresponded to a change of 55 V in the minimum sparking potential. The slope of the line was confirmed by independent work function measurements using the graph of the Richardson thermionic equation. The curves (ω/α) versus (E/p) showed a rapid increase in ω/α with decreasing values of E/p at $E/p < 100$ V/cm mm of mercury.

537.533 : 621.385.032.213.13

5329 INFLUENCE OF THE CATHODE WORK FUNCTION ON THE SPARKING POTENTIAL IN HYDROGEN.

D.E.Davies and R.K.Fitch.
Brit. J. appl. Phys., Vol. 10, No. 11, 502-5 (Nov., 1959).

The Kelvin or vibrating electrode method of measuring contact potential differences has been used to follow changes in work function of evaporated metallic films in a parallel plate electrode system in hydrogen at about 10 mm of mercury pressure. A reduction in cathode work function of the order of 0.3 eV was effected by passing a current of 10^{-7} A for 10 s. After about 30 min the cathode work function returned to its original value. Similar treatment caused a reduction in the sparking potential of 30 V, which also returned to its original pre-discharge value in times of the order of 30 min. This, together with other experimental data, is consistent with the fact that positive ions from the discharge current remained on the cathode surface for periods up to 30 min after the current was switched off. It has been possible to demonstrate that, while these positive ions are being neutralized, there is a relationship between the work function of a cathode and its sparking potential in hydrogen.

537.533

5330 ELECTRON EMISSION FROM PURE METAL SURFACES AT ROOM TEMPERATURE. M.V.Sinel'nikov.

Radiotekhnika i Elektronika, Vol. 3, No. 12, 1523-4 (1958). In Russian.

Electron emission from the surfaces of certain metals at room temperature without the action of external radiation or an electric field is investigated. This emission is explained as due to structural changes or chemical reactions in the surface layer or to the existence of supplementary electron surface states. The investigation was conducted to ascertain whether emission can occur from pure metals or only in the presence of impurities. Magnesium, aluminium and copper were examined. Currents of the order of 10^{-14} A, continuing for several days, were obtained from the magnesium and aluminium but no current was obtained from the copper. The preparation of the surfaces is described. [English summary: PB 141106T-11 obtainable from Office of Technical Services, U.S. Department of Commerce, Washington D.C., U.S.A.]. R.C.Glass

537.533

5331 THE ROLE OF FIELD EMISSION IN THE MAINTENANCE OF THE ELECTRICAL DISCHARGE AT THE CATHODE IN A GAS AT LOW PRESSURE. H.Doucet.

C. R. Acad. Sci. (Paris), Vol. 250, No. 6, 1007-9 (Feb. 8, 1960). In French.

A previous theory of the mechanism of low pressure gas discharges involves secondary emission from the cathode due to positive ion bombardment. It is pointed out that this theory does not predict a narrow distribution of electron velocities, as observed experimentally, and that the magnitude of the secondary emission coefficient for the cathode material will seldom be large enough to explain the maintenance of the discharge. It is suggested that field emission takes place from the cathode due to strong local potential gradients induced by the approach of positive ions to the cathode. Calculations suggest that the potential gradient in a cylindrical discharge between parallel plates is insufficient to produce field emission with the experimental arrangement adopted, but that in a conical discharge the field is sufficient. Experimental evidence is produced to show that at low pressures the discharge may, in fact, be conical. C.H.B.Mee

537.533

5332 CURRENT FLUCTUATIONS IN THE OXIDE CATHODE. M.Chisholm and L.Jacob.

Nature (London), Vol. 184, 1058-9 (Oct. 3, 1959).

Reports observations of the conduction and emission currents from (Ba,Sr)O cathodes under the influence of the anode field. Slow, large-amplitude fluctuations were observed in both currents for certain anode voltages. A.H.W.Beck

537.533

5333 REVERSIBLE POISONING BY SULPHUR, OXYGEN AND OTHER GASES OF OXIDE-COATED CATHODES AT HIGH TEMPERATURES. N.A.Surplice.

Brit. J. appl. Phys., Vol. 10, No. 8, 359-63 (Aug., 1959).

A simple mass spectrometer has been used to select and study the behaviour of the negative ions of sulphur and oxygen emitted by oxide-coated cathodes on recovery from the poisoning of their electron emission by these agents over the temperature range

1075-1300°K. Only the atomic ions were observed, and the behaviour of the $(S^{32})^-$ ion emitted on recovery from sulphur poisoning was similar to that of the $(O^{16})^-$ ion emitted on recovery from oxygen poisoning. The ion $C^{12}H^-$ also had a slight poisoning effect. Measurements of the energy distributions of these ions showed that, during recovery, many more of them were sputtered off the top surface of the cathode than were evaporated from its pores. These results support the hypothesis that high-temperature reversible poisoning is caused by the adsorption of negative ions on the internal and external surfaces of the porous oxide-coating.

537.533 : 621.387

5334 CATHODE EMISSION MEASUREMENTS IN LOW PRESSURE DISCHARGES.

A.D.Forster-Brown and M.A.Cayless.

Brit. J. appl. Phys., Vol. 10, No. 9, 409-11 (Sept., 1959).

A method described in an earlier paper (Abstr. 9252 of 1957) for measuring the zero field emission from hot cathodes in discharges is compared with that of the probe methods described by Found (Abstr. 3439 of 1934). Good agreement is obtained, thus supporting the interpretation of the measured characteristics. It is shown how this method may be applied to measure the emission from cathodes in ordinary long discharge tubes, such as fluorescent lamps, without the necessity for inserting probes or interfering with the construction of the tubes or electrodes in any way.

537.533

5335 THE EXO-ELECTRON AND THERMIONIC EMISSION OF SOME HALIDES. A.Bohun and J.Dolejší.

Czech. J. Phys., Vol. 9, No. 5, 578-89 (1959). In German.

Comparisons are made between experimental and theoretical warming curves of electron emission for crystals of NaCl and CaF_2 containing F-centres with special reference to the mono- and bi-molecular nature of the processes involved. The effect of work function on position of emission maxima (in temperature scale) and on emission intensity is calculated. These experiments provide information which leads to the possibility of making conclusions on the mechanism of thermionic emission from oxide coated cathodes.

G.F.J.Garlick

537.533

5336 ON THE PROBLEM OF EXO-ELECTRON EMISSION. R.Seidl.

Czech. J. Phys., Vol. 9, No. 5, 597-605 (1959). In German.

The dependence of exo-electron emission on the separate processes of activation of electrons from traps and their thermionic activation out of a solid is considered. The maxima in exo-electron emission "glow curves" are shown to depend on activation from traps rather than on the work function. The energy determined from the initial rise to the maximum emission usually corresponds to the work function.

G.F.J.Garlick

537.533 : 539.1.07

EXO-ELECTRON EMISSION AFTER REVERSAL OF POLARITY IN A COUNTING TUBE. See Abstr. 3873

537.533

5337 THE EXO-ELECTRON EMISSION OF GERMANIUM. R.Seidl.

Z. Phys., Vol. 157, No. 5, 568-75 (1960). In German.

The investigation of exo-electron emission for X-ray irradiated n-type germanium (10Ωcm.) is made over a specimen temperature range of 20 to 260°C. The electrons appear to come from internal traps in the specimens as shown by comparison of emission for different surface conditions, the emission probably depending on the effect of the surface roughness on internal electric field in the crystals.

G.F.J.Garlick

537.533 : 621.383.2

5338 THE THERMOEMISSION AND PHOTOEMISSION MAXIMA IN SILVER–CAESIUM PHOTOCATHODES. M.Partlová and L.Eckertová.

Czech, J. Phys., Vol. 9, No. 2, 263-5 (1959). In Russian.

From experiments on processing Ag-Cs photocathodes, it is found that the thermionic and photoemission current maxima need not necessarily occur simultaneously in activation. The highest integral sensitivity will only be obtained when the lowest work function occurs simultaneously with the formation of an optimum inner photocathode structure, and the conditions for this are considered to be difficult to attain in practice. It is recommended therefore, in the activation of photocathodes of high integral sensitivity, to monitor the photocurrent (instead of the thermionic current) and also the spectral characteristic.

V.V.Zakharov

537.533 : 535.3

REFLECTION OF LIGHT ON TRANSPARENT PHOTOCATHODES See Abstr. 5130

537.533

5339 THE SELECTIVE PHOTOELECTRIC EFFECT. W.T.Doyle.

Proc. Phys. Soc., Vol. 74, Pt 1, 27-32 (July 1, 1959).

The spectral selective photoelectric effect in alkali metals is considered as a local field phenomenon taking place in a colloidal surface structure. Treating the colloidal particles as spheroids containing a mixture of bound ion core and free valence electrons, an expression is derived for the wavelength for peak photoemission which is compared with the experiments on hydride cells and on thin films.

537.533

5340 AN X-RAY PHOTOCELL. B.Hess.

Z. angew. Phys., Vol. 11, No. 12, 449-53 (Dec., 1959). In German.

The passage of X-rays through matter releases photo-electrons. If the material is thin a given volume can be made to present a large area to an incident X-ray beam and a large photoelectric emission current is possible. By using two such sheets of different atomic number to form a parallel-plate condenser a large current will flow in a galvanometer connected between them during irradiation. A practical X-ray detector of this type having high sensitivity is described. The sensitivity is not greatly dependent on initial X-ray energy.

T.Mulvey

537.533 : 535.1

DISTRIBUTION OF COUNTS IN A PHOTOELECTRIC DETECTOR. See Abstr. 5124

537.533

5341 INVESTIGATION OF THE REFLECTION OF ELECTRONS FROM CERTAIN METALS. I.M.Bronshtein and R.B.Segal'.

Fiz. tverdogo Tela, Vol. 1, No. 8, 1246-9 (Aug., 1959). In Russian.

The coefficient of secondary electron emission is divided into two parts, respectively relating to secondaries of energies less than and greater than 50 eV. These are determined experimentally as a function of incident energy and angle of incidence for Pt, Ag, W, Bi and Be. The coefficients at first rise rapidly with energy and later become constant or fall off slowly.

A.E.I. Research Laboratory

537.533

5342 THE ENERGY DISTRIBUTION OF ELECTRONS RELEASED BY IONS AND ELECTRONS IN TRAVERSING THIN FOILS. W.Dietrich and H.Seiler.

Z. Phys., Vol. 157, No. 5, 576-85 (1960). In German.

An electron velocity spectrometer of high resolving power (0.1 eV) was used to measure the energy distribution of electrons released from Ni, Ag, Al, C and KCl foils by ion and electron bombardment. The spectrometer was placed on the side of the foil away from the source. It was found that the energy distributions resulting from ion bombardment were influenced by the atomic number of the target; those from electron bombardment were not. Ion bombardment spectra also had greater half-widths than those resulting from electron bombardment. The effect of lens aperture on reducing the half-width of the energy spectrum transmitted by the lens was investigated in some detail.

T.Mulvey

537.533 : 621.385.833

5343 SINGLE-VELOCITY EQUIVALENTS FOR MULTIVELOCITY ELECTRON STREAMS. G.A.Gray.

J. appl. Phys., Vol. 31, No. 2, 370-80 (Feb., 1960).

Several electron beam problems which involve a distribution in electron velocities are treated. In each case the actual multi-velocity stream is replaced by an equivalent single-velocity stream. Such a procedure provides a common viewpoint for the examples which are considered. For a travelling-wave tube, it is found that a distribution of d.c.electron velocities has the same effect as an increase in the space charge parameter Q.C. a result which is in agreement with the earlier findings of Watkins and Rynn. Agreement with earlier theories is also found in the cases of space charge wave propagation on a multi-velocity stream, and the doublestream amplifier. In the case of noise fluctuations in high velocity beams, it is found that the time varying part of eithr the r.m.s. or the mean

stream velocity may by used to specify the a.c. velocity modulation on the equivalent single-velocity beam. That is, either value should be equally valid in a first order treatment. Finally, a class of re-entrant beam devices is analysed, and experimental results are cited as an indication of the validity of the theory.

537.533 : 621.385.833

5344 ON THE CONCEPT OF FICTITIOUS SURFACE CHARGES OF AN ELECTRON BEAM. E.L.Chu.
J. appl. Phys. Vol. 31, No. 2, 381-7 (Feb., 1960).

The electrodynamical phenomena in the boundary strip of a sharply focused electron beam are extremely complicated. This difficulty is usually resolved by postulating a layer of surface current on the boundary of the unperturbed beam while considering the troublesome boundary strip as nonexistent. A critical examination is made of this technique with the result that, if the calculated r.f. power is to be the same as in the actual beam, a layer of electric dipoles must also be postulated. The discussion begins with the Jacobian and Taylor's expansion, with particuar emphasis on the applicability of the latter to the boundary strip, then proceeds to the formulation of a modified problem on an equal-power basis and specification of the surface conditions which are to be satisfied. Second-order quantities are included in all equations, so that the small-signal beam kinetic quatities can be reliably calculated.

537.533

5345 CONDITIONS FOR LAMINAR FLOW OF A FOCUSED ELECTRON BEAM. P.Szulkin.
Bull. Acad. Polon. Sci. Ser. Sci. tech., Vol. 7, No. 11, 651-4 (1959).

Develops the criterion

$$\frac{\partial}{\partial r_0}[r_0\,\delta(r_0,z)] > -1$$

for the perturbation of a cylindrical beam to be laminar, where

$$r/r_0 = 1 + \delta(r_0,z)$$

is the disturbed trajectory of an electron of equilibrium radial distance r_0. An application is made to special cases of sinusoidal perturbation to obtain values of z_{max} and t_{max}, the maximum distances and times for which the beam remains laminar. The theory is extended to more complex cases. B.Meltzer

537.533 : 621.385.833

5346 LAMINAR FLOW IN MAGNETICALLY-FOCUSED CYLINDRICAL ELECTRON BEAMS. J.L.Palmer.
I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 262-9 (July, 1959).

The behaviour of a cylindrical electron beam in a magnetic field is discussed in terms of a laminar-flow model. By numerical integration of the equations of motion, the maximum and minimum radii of excursion and the wavelength of the undulations for each electron are presented in graphical form for various boundary conditions on the electron beam. By proper selection of boundary conditions, e.g., magnetic field strength at the cathode, the graphs are utilized to describe Brillouin flow, space-charge-balanced flow, immersed flow, confined flow, and, in fact, any electron flow which satisfies the laminar flow criterion. The perturbations introduced by improper injection conditions for any of the flows mentioned can be read directly from the graphs. A study of the wavelength and amplitude of such perturbations as a function of radial position in the beam determines if a given type of flow with given injection conditions satisfies the laminar flow criterion. The sensitivity of various types of electron flow to misadjustments of the boundary conditions is clearly revealed by the graphs; e.g., the amplitude of the undulations in Brillouin flow is very sensitive to the adjustment of the magnetic field strength, whereas for immersed flow, a similar deviation in magnetic field strength has very little effect on the amplitude of the undulations.

537.533 : 621.385.833

5347 THE RADIO-FREQUENCY CURRENT DISTRIBUTION IN BRILLOUIN FLOW. M.Chodorow and L.T.Zitelli.
I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 352-7 (July, 1959).

It has been shown than in an electron beam with Brillouin focusing, two pairs of space-charge waves are possible. One pair has the peculiar property of having no r.f. charge density in the volume of the beam, with most of the current being caused by ripples of the boundary. It is shown that, in the case of modulation by the gridless gap of a klystron, it is only these spacecharge waves which are excited in the electron beam. This result has also been verified elsewhere by experiment. In addition to the detailed calculation, a simple proof is given which demonstrates why one gets particular behaviour predicted by the detailed theory, namely, a modulated beam with no r.f. charge density in the volume. This effect arises from the fact that the modulation is produced by an electric field with zero divergence, and therefore the r.f. velocity produced also has zero divergence. Zero divergence of the velocity is the condition for an incompressible fluid, i.e., constant density. In the case of modulation by a grid, the electric field does have zero divergence and this kind of behaviour does not occur.

537.533

5348 COHERENT SPLITTING OF AN ELECTRON BEAM BY MAGNETIC FIELDS. E.Krimmel.
Z. Phys., Vol. 158, No. 1, 35-8 (1960). In German.

A Fresnel biprism for an electron interference experiment was realized by passing the electron beam through the field of two adjacent, anti-parallel electromagnets. The interference pattern showed there was superposition of three coherent electron wave-trains, not the expected two only, the third coming from a real source on the axis of the system. An optical analogue was demonstrated by rounding the refracting surfaces of a biprism.

B.Meltzer

537.533

5349 STUDY OF ELECTRON OPTICS IN THE ELECTROLYTIC TANK IN THE PRESENCE OF SPACE CHARGE BY THE METHOD OF CURRENT INJECTION. J.Bonnerot.
C.R. Acad. Sci. (Paris), Vol. 249, No. 19, 1878-80 (Nov. 9, 1959). In French.

Representation of the space charge in electron optical systems simulated by an electrolytic tank requires the injection of currents at discrete points, chosen afresh for each problem. It proves best to dispose the injection points on equipotentials, in the case of rotational symmetry, linking these by external resistances. The system is applied to the study of a reflex klystron.

A.E.I. Research Laboratory

537.533

5350 MASS SEPARATION OF HIGH ENERGY PARTICLES IN QUADRUPOLE LENS FOCUSING SYSTEMS.
E.D.Courant and L.Marshall.
Rev. sci. Instrum., Vol. 31, No. 2, 193-6 (Feb., 1960).

In systems for mass separations of high energy particles, the separation achieved depends not only on the applied electric field but also on the characteristics of the systems of magnetic lenses which may be used to contain and focus the beam of particles. Quantitative relations for the mass separation and momentum dispersion are derived. It is shown that systems can be designed involving a module of magnetic lenses and electric field such that, when the module is repeated indefinitely, the mass separations at successive foci increase linearly with the number of modules.

537.533

5351 CONSTRUCTION OF AN EMISSION MICROSCOPE OPERATED BY HIGH VOLTAGE PULSES. J.Gardez.
C.R. Acad. Sci. (Paris), Vol. 249, No. 20, 2034-6 (Nov. 16, 1959). In French.

The resolving power of the emission electron microscope improves linearly with accelerating voltage. For a given electron gun, higher peak voltages may be applied in the form of pulses than under steady conditions. A suitable gun construction for pulse working is described together with preliminary results obtained.

A.E.I. Research Laboratory

537.533

5352 SPHERICAL ABERRATION OF ELECTROSTATIC LENSES OF ROTATIONAL SYMMETRY WITH LARGE APERTURES. SYMMETRICAL HYPERBOLIC LENSES AND ASYMMETRICAL LENSES. A.Septier and M.Ruytoor.
C.R. Acad. Sci. (Paris), Vol. 249, No. 25, 2746-8 (Dec. 21, 1960). In French.

Briefly reports measurements of the spherical aberration of eight electrostatic lenses with clear diameter greater than 30 cm to allow the passage of wide-angle beams of electrons (up to 20° semi-angle). Both third and fifth order terms are involved. In most of these lenses an attempt has been made to create a hyperbolic field in the central region of the lens. T.Mulvey

537.533

5353 INVESTIGATIONS OF [ELECTRON] FILTER LENSES. E.Hahn.

Exper. Tech. der Phys., Vol. 7, No. 6, 258-68 (1959). In German.

Computations were carried out of the positions of the object plane and the exit pupil required to give achromatism of an electrostatic filter lens of the unipotential type. The variation of the saddle-voltage with the voltage U_L applied to the middle electrode of the lens was also computed. On the basis of these results the optimum operating conditions were deduced for a lens to reject all electrons that had suffered more than 10 V loss in a beam of 40 kV. Micrographs show the variation in the properties of the lens as U_L was changed in steps of 2 V. The effect of the filter lens is greater than that of a contrast aperture in bringing out detail in a thin section of biological material. The mathematical treatment will be separately published. V.E.Cosslett

537.533 : 518

5354 TRAJECTORY PLOTTING IN ELECTRON GUNS. G.D.Archard.

Proc. Phys. Soc., Vol. 74, Pt 2, 177-82 (Aug., 1959).

A method of presenting space charge on a resistance network analogue by means of leak resistances is described and applied to the determination of trajectories in several conventional and unconventional electron guns.

537.533

5355 ELECTRON OPTICAL PREPARATION OF SELF-SUPPORTING MICROGRIDS. H.Boersch, H.Hamisch and K.H.Löffler.

Naturwissenschaften, Vol. 46, No. 21, 596 (1959). In German.

The method relies on the insolubility produced in organic substances by electron irradiation. A metal grid of period 50 μ is reduced 17 times by electron optical projection, the image being formed on a copper plate coated with lacquer. After removal of lacquer with solvent from the unirradiated regions, nickel is deposited electrolytically on the copper and the copper then dissolved with chromic acid. The final nickel grid has a period of 3 μ; circular apertures of 1 μ diameter have also been made by this method. The required electron dose is between 10^{-5} and 10^{-6} A cm^{-2}. Still finer apertures and grids should be obtainable. V.E.Cosslett

537.533 : 541.18

5356 FIELD EFFECTS ON CHEMISORBED FILMS IN ELECTRON EMISSION MICROSCOPY. R.J.Hill and P.W.M.Jacobs.

Nature (London), Vol. 184, 895-6 (Sept.19, 1959).

The rate of adsorption of oxygen and carbon dioxide on tungsten at pressures of about 3×10^{-8} mm Hg is considerably increased by the application of a high electric field. It is suggested that the roughness of the tungsten emitter causes inhomogeneities in the field, and polarized adatoms or admoles tend to move to sites where their free energy is a minimum, i.e., where the field is highest. C.H.B.Mee

ION EMISSION . ION BEAMS

537.534

5357 THERMOEMISSION OF ALLOYS. K.F.Wojciechowski.

Acta phys. Polon., Vol. 17, No. 4, 257-64 (1958).

A semi-phenomenological theory is presented for binary and ternary alloys which form superlattices at low temperatures. It is found that the thermoemission current has a local anomaly in the neighbourhood of the order–disorder transformation temperature. The character of this anomaly (maximum or minimum) depends on whether the order–disorder transformation is a first-order or second-order phase transition. Richardson's formula is derived for the alloys undergoing an ordering process; Richardson's constant A for these alloys is a function of the parameters of long-range order. It is noted that the thermoemission current for alloys with a non-cubic crystal lattice is anisotropic.

537.534

5358 A VACUUM DISTILLATION CAMERA USING RADIOACTIVE METAL SOURCE. L.E.Preuss.

Nucleonics, Vol. 18, No. 1, 102-3 (Jan., 1960).

A pinhole camera with a radioactive source together with autoradiography of the target enables images of weak thermionic sources to be obtained. R.D.Smith

537.534

5359 SURFACE IONIZATION SOURCE FOR MASS SPECTROMETRY. R.D.Craig.

J. sci. Instrum., Vol. 36, No. 1, 38-9 (Jan., 1959).

The source described is based on the principle of replacement of the usual "source slit" by a demagnified image of the ionizing filament. Using a 0.030 in. wide filament and 0.040 in. wide slits an effective source width of 0.003 in. has been obtained.

537.534

5360 CALCULATION OF THE ION OPTICAL PROPERTIES OF INHOMOGENEOUS MAGNETIC SECTOR FIELDS: NOTE ON THE TRAJECTORIES OUTSIDE THE MEDIAN PLANE WITH OBLIQUE INCIDENCE, AND ON THE SECOND ORDER ANGULAR ABERRATION COEFFICIENT. H.A.Tasman, A.J.H.Boerboom and H.Wachsmuth.

Z. Naturforsch., Vol. 15, No. 1, 78-9 (Jan., 1960).

537.534

5361 STRONG-FOCUSING ION SOURCE. E.T.Kinzer and H.Carr.

Rev. sci. Instrum., Vol. 30, No. 12, 1132 (Dec., 1959).

The use is reported of electric quadrupole lenses for producing a line focus of ions acting as the defining slit in a mass spectrometer using a modified Winn–Nier type ion source. With this arrangement, ion currents for the HOH^+ and H^- ions derived from a mixture of background air, methyl alcohol and water vapour in the source at 6×10^{-5} mm Hg pressure were 2×10^{-11} A and 2×10^{-13} A respectively. These currents were a factor of about 100 greater than any previously observed under similar conditions with a conventional defining slit. R.E.Meads

537.534

5362 APPARATUS DRAWINGS PROJECT. REPORT NUMBER 5. SMALL MASS SPECTROMETER. R.G.Marcley.

Amer. J. Phys., Vol. 28, No. 4, 380-3 (April, 1960).

A small-radius 180° mass spectrometer of a very simple type is described. The ion source is a tungsten filament coated with a salt of the material to be investigated. Using Li^7, a magnetic field of 1000 G, and an accelerating potential of 100 V, a detector current of 10^{-11} A is obtained. The resolving power is 33.

537.534

5363 A MAGNETIC ANALYSER FOR 12 MeV DEUTERONS. A.Gonze.

Ann. Soc. Sci. Bruxelles I, Vol. 73, No. 3, 414-19 (1959). In French.

The design of an electromagnet designed to deflect 12 MeV deuterons through an angle of 55° with a radius of curvature of 50 cm is described. The instrument is to be used in conjunction with 12 MeV cyclotron at the Institute of Nuclear Physics, Louvain University. A.E.I.Research Laboratory

537.534

5364 ON THE POSSIBILITY OF REDUCING THE ABERRATION COEFFICIENTS IN ANALYSERS WITH NON-UNIFORM FIELDS. M.I.Korsunskii and V.V.Zashkvara.

Pribory i Tekh. Eksper., 1959, No. 3, 21-5 (May-June). In Russian.

A theoretical examination is made of the ion-optical properties of an electrostatic analyser with n sectors. The angles subtended by successive sectors are independent. It is shown that by choosing correctly the field in a single sector the fundamental coefficient of aberration can be reduced to zero in an instrument of high dispersion. J.H.Fremlin

PARTICLE ACCELERATORS

537.54

5365 ELECTROSTATIC TRANSFORMER TYPE PARTICLE ACCELERATOR USING CERAMIC $BaTiO_3$–FERROSTAC. T.Shibata, A.Toi, T.Suita and S.Kisaka.

J. Phys. Soc. Japan, Vol. 14, No. 2, 227 (Feb., 1959).

A 150 kV rotating disk electrostatic transformer has been constructed with ceramic $BaTiO_3$ disks, and used in a deuteron accelerator. A beam current of 100 μA is obtained, and a resulting neutron intensity of 10^9 n/sec. Advantages claimed for the electrostatic generator are, simple construction, low cost, and high beam current. Further generators of 400 kV and 1 MV are stated to be under construction. L.E.Cross

537.54

5366 ALTERNATING-GRADIENT FOCUSING IN LINEAR ACCELERATORS. A.D.Vlasov.
J. nuclear Energy, Vol. 5, No. 1, 62-70 (1957). English translation of article in: Atomnaya Energiya Vol. 1, No. 5, 20 (1956).

A linear theory of alternating-gradient or "strong" focusing in linear ion accelerators is presented.

537.54 : 518

5367 COUNTER-COMPUTER FOR THE INVESTIGATION OF THE MOTION OF PARTICLES IN AN ELECTRON LINEAR ACCELERATOR.
I.F.Kharchenko, R.M.Nikolaev, A.M.Nekrashevich and P.M.Zeidlits.
Pribory i Tekh. Eksper., 1959, No. 3, 71-6 (May-June). In Russian.

A mechanical counter-computer is described for the calculation of the longitudinal motion of charged particles. The computer makes possible the calculation of the phase-excursions of particles under various conditions of acceleration. Photographs and a detailed diagram show the mechanical turn-table integrators, their interconnections and the electro-mechanical feedback system required to simulate the equations of motion of the particles. The system was used to calculate the longitudinal motions of electrons in sections of a linear accelerator $\frac{1}{2}$, 1 and 2 m long for an accelerating wavelength of 10.7 cm. A range of each of the parameters was taken. Calculation of the phase oscillations of a single particle for a $\frac{1}{2}$ m section took 5-7 minutes, whereas calculation by numerical integration would have required 3-4 working days. A set of curves is presented for particles having initial phases from -150° to 150° from the median value. The final result gave the energy-spectrum, current and phase-width of the bunches with adequate accuracy for practical purposes. J.H.Fremlin

537.54

5368 HISTORY OF THE CYCLOTRON.
I. M.S.Livingston. II. E.M.McMillan.
Phys. Today, Vol. 12, No. 10, 16-23, 24-34 (Oct., 1959).

Two lectures in memory of E.O.Lawrence. They form a continuous history of the original cyclotron through the personal experience of the authors.

537.54

5369 THE 10 GeV PROTON SYNCHROTRON OF THE USSR ACADEMY OF SCIENCES. V.I.Veksler, D.V.Efremov, A.L.Mints, M.M.Veisbein, F.A.Vodopyanov, M.A.Gashev, A.I.Zeidlits, P.P.Ivanov, A.A.Kolomensky, I.F.Malyshev, N.A.Monoszon, I.Kh.Nevyazhsky, V.A.Petukhov, M.S.Rabinovich, S.M.Rubchinsky, K.D.Sinelnikov, and A.M.Stolov.
J. nuclear Energy, Vol. 4, No. 3, 333-9 (March, 1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 4, 22 (1956).

The basic characteristics of the synchrotron are described briefly, in particular the electromagnet and its supplies, the vacuum system, the high frequency supply and the acceleration control system. The design is discussed in greater detail in papers read to the accelerator section of the All-Union Conference on High Energy Particle Physics, Moscow, 1956. J.W.Sturgess

537.54

5370 THE EXTRACTION OF HIGH-ENERGY PARTICLE-BEAMS THROUGH THE YOKE OF THE SYNCHRO-CYCLOTRON ELECTROMAGNET.
A.E.Ignatenko, V.V.Krivitsky, A.I.Mukhin, B.Pontecorvo, A.A.Reut, and K.I.Tarakanov.
J. nuclear Energy, Vol. 5, No. 1, 57-61 (1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 5, 5 (1956).

A method is described for obtaining collimated beams of high-energy particles, in particular π-mesons, based on the use of the electromagnet yoke as the main shield from the direct radiation of the accelerator. By placing collimators in channels drilled in the electromagnet yoke, beams of π-mesons with energies up to 400 MeV have been obtained.

MAGNETISM

(The magnetic properties of solids are included under Solid-State Physics; similarly for Liquid State and Gaseous State)

538

5371 METHOD OF REDUCING THE EFFECTS OF VIBRATION IN A MAGNETIC RING BALANCE.
C.A.Clark and J.E.Whittle.
J. sci. Instrum., Vol. 36, No. 4, 190-1 (April, 1959).

A damping arm, pivoted near its centre of gravity, has been added to the ring of a Sucksmith magnetic balance in order to reduce the response to external vibration. The mass of the damping arm is distributed to provide a large inertia to vibration at the resonance frequency of the spring system, without appreciably affecting its sensitivity.

538 : 621.317.44

5372 A ROCKET-BORNE MAGNETOMETER.
K.Burrows.
J. Brit. Instn Radio Engrs, Vol. 19, No. 12, 769-76 (Dec., 1959).

The geophysical reasons for requiring magnetic measurements in the upper atmosphere and the general and instrumental considerations involved in using a Skylark rocket for the purpose are outlined. The principles of the measuring technique employing a proton precession magnetometer and the reasons for its selection are discussed. The application of these principles to the design, construction and testing of a practical instrument are described.

538 : 539.2 : 537.311

5373 A MAGNETOMETER BASED ON THE HALL EFFECT.
D.P.Vasilev'skaya and Yu.N.Denisov.
Pribory i Tekh. Eksper., 1959, No. 3, 144-5 (May-June). In Russian.

Describes a device for measuring constant magnetic fields from 100 to 17 500 Oe in 5 ranges with an accuracy of $\pm$ 1%, assuming a temperature of 20 $\pm$ 5°C and relative air humidity not greater than 80%. The basic element is an n-type Ge crystal measuring $2 \times 1.5 \times 0.7$ mm^3 through which a constant current of 1 mA passes (resistance = 47 ohm), the sensitivity being 4.3 μV Oe^{-1}. D.E.Brown

538.1 : 621.318.37

5374 SOLENOID PAIR FOR PRODUCTION OF A SEVENTH-ORDER EXTERNAL FIELD.
J.A.Jungerman and C.G.Patten.
Rev. sci. Instrum., Vol. 31, No. 2, 171-2 (Feb., 1960).

The magnetic field is calculated for a coaxial pair of solenoids having an external axial field which decreases as the inverse seventh power of the distance from the solenoid centres. The effect of finite coil thickness is discussed.

538.1 : 536.48

5375 SUSCEPTIBILITY OF SUPERCONDUCTING SPHERES.
R.M.May and M.R.Schafroth.
Proc. Phys. Soc., Vol. 74, Pt 2, 153-60 (Aug., 1959).

An expression for the magnetic susceptibility of a sphere in a homogeneous applied field is derived, assuming a quite general linear relation between the magnetization M and induction B inside the sphere. This expression is of interest in analysing experimental results on fine-grained colloidal suspensions of superconductors.

538.1 : 621.318.2

5376 THE PULSE MAGNETIZATION OF PERMANENT MAGNETS. N.M.Rodigin.
Fiz. Metallov i Metallovedenie, Vol. 6, No. 2, 368-9 (1958). In Russian.

Points out that the usual d.c. magnetization of permanent magnets amounts to three processes, the first and last of which are transient (on switching on and off), whilst the second is steady-state. The second process is unnecessary and the third unavoidable. Pulse magnetization basically requires an ignitron, thyratron, peak transformer and capacitor. For a circuit working directly off 50 c/s a.c. supplies, see Rodigin, Fiz. Metallov i Metallovedenie, Vol. 4, No. 2, 377-8 (1957). The greatest cross section of magnico alloy so far pulse-magnetized is 15 cm^2. Advantages of the method are compact equipment, economy and saving of time. D.E.Brown

538.1 : 621.318.2

5377 SOME ASPECTS OF THE DESIGN OF LARGE PERMANENT MAGNETS. J.E.Cousins and W.F.Nash.
Brit. J. appl. Phys., Vol. 10, No. 11, 471-5 (Nov., 1959).

The design and construction of a large permanent magnet for use in cosmic ray studies is considered. It is shown that there is an optimum distribution of the magnetic material in order to obtain either a maximum field, H, or a maximum line integral, $\int_{-\infty}^{+\infty} H dy$, for a given pole face area and gap size. If has been shown that a good value of the leakage factor for use in the design calculations for magnets with rectangular pole faces can be predicted theoretically. Detailed comparison between results predicted by this theory and those obtained in practice with the present magnet and other large permanent magnets suggest that these calculations can be usefully applied to magnets with pole faces of any shape. These comparisons also show, in agreement with Andrew and Rushworth (1955), that demagnetization curves for small specimens of magnetic material are not reliable where large blocks are considered.

ELECTROMAGNETISM
MAGNETOHYDRODYNAMICS

538.3 : 530.12

UNIFIED FIELD THEORY OF GRAVITATION AND ELECTRICITY. See Abstr. 4937

538.3

5378 GENERALIZED LINEAR ELECTRODYNAMICS. I. J.I.Horváth and B.Vasvári.
Acta phys. Hungar., Vol. 7, No. 3, 277-88 (1957).

A generalization of Podolsky's theory of higher order (Abstr. 206 of 1943). The original field equations of higher order of Podolsky's theory are deduced from a new Lagrangian and the canonical formalism of the field, as well as the laws of conservation in the classical case, are investigated.

538.3

5379 A UNIQUENESS THEOREM FOR THE FIELD OF AN ALTERNATING CURRENT IN A WIRE IN THE NEIGHBOURHOOD OF A CONDUCTING MEDIUM. I.Ferrari.
Atti. Accad. Sci. Torino I, Vol. 94, No. 1, 77-88 (1959-60).
In Italian.

538.3

5380 MAGNETOFLUIDMECHANICS. SOME COMMENTS IN MEMORY OF DONÁT BÁNKI. T.von Karman.
Acta tech. Hungar., Vol. 27, No. 1-2, 41-51 (1959).

Review of the fundamentals and applications.

538.3

5381 ENERGY CONSIDERATIONS IN MAGNETOHYDRODYNAMICS. G.Carini.
R.C. Accad. Naz. Lincei, Vol. 27, No. 1-2, 48-53 (July-Aug., 1959).
In Italian.

An energy conservation theorem is obtained, based on the expression

$$(8\pi)^{-1}[\epsilon E^2 + \mu H^2 - (2/c)(\epsilon\mu - 1)\, \underline{v} \cdot \underline{E} \times \underline{H}]$$

for the electromagnetic energy in a medium whose velocity is v. The theorem is then applied to the special case of adiabatic processes in an inviscid perfectly conducting fluid. O.Penrose

538.3

5382 ON THE SIMILARITY RULE IN MAGNETO-GASDYNAMICS. M.Z.v.Krzywoblocki and J.Nutant.
Acta Phys. Austriaca, Vol. 13, No. 1, 1-18 (1960).

A diabatic flow is considered to be a flow of an inviscid, non-heat conducting fluid with heat addition by means of sources, i.e. injection of heat. If, in addition, the flow takes place in an electromagnetic field, the sources of heat may be referred additionally to the Joule heat. This case is considered in the present paper. The governing fundamental equations are: the first law of thermodynamics, Newton's equation of motion, pressure–density–entropy relation, Bernoulli's equation of energy, Maxwell's equations and Ohm's law. The two dimensional equations of the velocity potential and of the stream-function are transformed into the hodograph plane. Assuming a simplified pressure–density relation, a similarity rule is derived in the flow in question. This is applied to some particular problems.

538.3

5383 COMMENTS ON "EXPERIMENTAL DEMONSTRATION OF HYDROMAGNETIC WAVES IN AN IONIZED GAS". J.M.Wilcox and F.I.Boley.
Phys. of Fluids, Vol. 3, No. 1, 141-2 (Jan.-Feb., 1960).

Sawyer, Scott and Stratton (Abstr. 3655 of 1959) reported the observation of hydromagnetic waves in a discharge plasma. It is pointed out here that under these experimental conditions hydromagnetic waves would theoretically be strongly damped.

O.Penrose

538.3

5384 THE EQUATIONS OF ADIABATIC MAGNETODYNAMIC EQUILIBRIUM OF A UNIFORMLY ROTATING AND GRAVITATING GASEOUS FLUID MASS. C.Agostinelli.
R.C. Accad. Naz. Lincei, Vol. 26, No. 5, 665-70 (May, 1959).
In Italian.

It is shown that the field is necessarily axially symmetrical, and that the magnetohydrodynamic equations reduce to two partial differential equations in which the dependent variables are essentially the density and H_ϕ. O.Penrose

538.3

5385 HYDROMAGNETIC WAVES IN A COMPRESSIBLE FLUID CONDUCTOR. J.Carstoiu.
Proc. Nat. Acad. Sci. U.S.A., Vol. 46, No. 1, 131-6 (Jan., 1960).

An attempt is made to generalize Alfvén wave propagation for a medium in which density varies with position or time. Using the quantities, vorticity ($\omega = \frac{1}{2}$ curl velocity) and current density, a set of equations is derived. It is shown that the components of these quantities in the direction of the magnetic field are propagated in the Alfvén manner along the field lines. Expressions for the variation of density are given. A.H.Gabriel

538.3

5386 FLOW OF A CONDUCTING FLUID IN THE PRESENCE OF THE MAGNETIC FIELD CREATED BY A LINE ELECTRIC CURRENT, AND ITS DETERMINATION BY THE METHOD OF RHEOELECTRIC ANALOGIES. G.Hacques.
C.R. Acad. Sci. (Paris), Vol. 250, No. 2, 284-6 (Jan. 11, 1960).
In French.

The steady flow of a conducting fluid in an external magnetic field is treated theoretically, the induced current being treated as a perturbation. The pressure perturbation is shown to satisfy an equation of the form of Poisson's equation, which can be solved by a resistance network analogue. This method is used to study flow in the field of a line current, and numerical results are presented graphically. O.Penrose

538.3

5387 FLOW OF A VISCOUS CONDUCTING LIQUID ROUND AN INFINITE CYLINDER IN THE PRESENCE OF A MAGNETIC FIELD. R.Ya.Damburg.
Latv. PSR Zinat. Akad. Vestis, No. 5 (142), 81-4 (1959). In Russian.

The velocity and magnetic field at infinity are taken parallel to each other and perpendicular to the cylinder. Both the Reynolds number and the magnetic Reynolds number are taken to be negligibly small. The resulting simplified equations of motion are solved in terms of Bessel functions with the Hartmann number as a parameter. For the case of very small cylinder radius, the drag force is also obtained. O.Penrose

538.3

5388 RADIAL PULSATIONS OF AN INFINITE CYLINDER IN THE PRESENCE OF MAGNETIC FIELD. J.N.Tandon and S.P.Talwar.
Indian J. Phys., Vol. 32, No. 7, 317-22 (July, 1958).

The general equation governing the radial pulsations of an infinite cylinder having volume currents has been derived and the integral formulae for the frequency of pulsations are deduced for two models of current density, viz., (i) circular currents and (ii) line currents. It is found that the cylinder remains dynamically stable for the two models of current systems.

538.3

5389 VELOCITY DISTRIBUTION IN ELECTROMAGNETIC PUMP CHANNELS, WITH A RECTNAGULAR CROSS-SECTION. Yu.Birzvalk and A.Veze.
Latv. PSR Zinat. Akad. Vestis, No. 10 (147), 85-9 (1959). In Russian.

Shercliff's method of solution of the Navier-Stokes equation (Abstr. 4220 of 1953) is used, while replacing the magnetic field intensity by a scalar electric potential. Approximate (least square) solutions are obtained. J.K.Skwirzynski

538.3 : 550.3

5390 PROPAGATION OF INDUCED FIELDS THROUGH THE CORE. P.H.Roberts.

Ann. Geophys., Vol. 15, No. 1, 75-86 (Jan.-March, 1959).

A study is made of the hydromagnetic propagation of small magnetic disturbances from a source within a finitely conducting fluid to its boundary. The results are applied to the problem of the rate of growth of the magnetic field due to the centres of secular change.

538.3

5391 INDUCTION DRAG. K.P.Chopra.

Indian J. Phys., Vol. 31, No. 6, 332-3 (June, 1957).

The problem is considered of the induction drag of a sphere of finite and constant electrical conductivity moving in an incompressible and non-viscous conducting fluid in a uniform magnetic field.

538.3 : 534.21

5392 SOUND PULSES IN A CONDUCTING MEDIUM. F.G.Friedlander.

Proc. Cambridge Phil. Soc., Vol. 55, Pt 4, 341-67 (Oct., 1959).

A mathematical treatment of the propagation of small disturbances in a perfectly conducting compressible fluid in a magnetic field which is uniform when undisturbed. Only the case where Alfvén modes are not excited is considered. A study of the propagation speeds of fast and slow magnetoacoustic waves in different directions shows that from an instantaneous point source two wave fronts spread out. The outer front is a rotationally symmetrical convex surface, flattened in the direction of the applied field; the inner fronts are conoidal, with concave bases and zero opening angle, so that meridional sections have cusps at the vertex of the conoid. For the case of an arbitrary initial pressure and zero initial velocity and field perturbations, a formal solution of the equations of motion is derived. If the initial pressure disturbance is highly localized, an approximate treatment of this formal solution gives estimates of the size of the propagating pressure disturbance associated with the wave fronts. Surprisingly, the largest part of this disturbance is the part associated with the vertex of the conoid; it falls away as $r^{-1/2}$, in contrast with r^{-1} for the other parts. O.Penrose

ELECTROMAGNETIC WAVES AND OSCILLATIONS

538.56

5393 ZERO-FIELD MASERS. G.S.Bogle and H.F.Symmons.

Austral. J. Phys., Vol. 12, No. 1, 1-20 (March, 1959).

Solid state three-level masers operating with zero magnetic field are shown to be feasible and to have advantages over magnetic field masers in many applications. The requirements of the working substance are discussed and it is found that compounds of Cr^{3+}, Fe^{3+}, Ni^{2+}, and Gd^{3+} should be suitable. Diagrams and tables of maser properties of selected compounds are given; on the basis of present knowledge a number of amplifying frequencies between 120 and 75 000 Mc/s should be available. The range of suitable compounds which has been studied is very small, and should be extended.

538.56

5394 RELAXATION TIME AND MULTIPLE PUMPING EFFECTS IN MASERS. A.Szabo.

Canad. J. Phys., Vol. 37, No. 12, 1557-61 (Dec., 1959).

The factors governing the operating temperatures of solid-state masers are considered, with the object of improving performance at higher temperatures. The use of multiple pumping and relaxation time ratio effects are considered in detail. It is concluded that optimization of relaxation time ratios combined with multiple pumping cannot, by itself, extend operating temperatures to above the liquid nitrogen range and still give performance comparable with that at present attainable at liquid helium temperatures by the basic three level maser. S.A.Ahern

538.56 : 621.375.9

5395 SUBMILLIMETER WAVE MASER. S.M.Bergmann.

J. appl. Phys., Vol. 31, No. 2, 275-6 (Feb., 1960).

It is shown that coherent emission between the levels $3^2P_{3/2}$–$3^2P_{1/2}$ for Na atoms enclosed in a resonant cavity should occur at a rate greater than in free space where transition probabilities are very low. It is therefore proposed to operate a maser at the submillimetre wavelengths corresponding to these transitions ($\nu = 5.18 \times 10^{11}\text{sec}^{-1}$) using a dielectric tube resonator as the cavity. An input and output coupling scheme is discussed.

538.56 : 621.375.9

5396 OPERATING CHARACTERISTICS OF A MOLECULAR-BEAM MASER. H.G.Venkates and M.W.P.Strandberg.

J. appl. Phys., Vol. 31, No. 2, 396-9 (Feb., 1960).

General expressions for the emitted power and the frequency pulling in an ammonia maser are deduced. The operating characteristics of the maser are deduced by introducing a mean-square time of flight of molecules in the cavity.

538.56 : 621.375.9 : 621.382

5397 THE GRAIN-BOUNDARY AMPLIFIER. O.A.Weinreich, H.Mataré and B.Reed.

Proc. Phys. Soc., Vol. 73, Pt 6, 969-72 (June, 1959).

Describes how the sheet conductance at a grain boundary in a semiconductor can be modulated by an electric field, leading to amplification. It is shown that the low-temperature limit for this amplifier is practically unlimited; but the upper limit is probably similar to that for other semiconductor devices involving junctions. Measurements have been made on n-type germanium samples. These have input resistance of approximately $10^6\ \Omega$ at room temperature, increasing to approximately $10^7\ \Omega$ at low temperatures. At 76°K and 4.2°K the power amplification was 21 dB and 23 dB respectively at 1 kc/s, dropping to half at 10 kc/s and approaching zero at 50 kc/s. S.A.Ahern

538.56 : 621.375.9

5398 THEORY OF FAST-WAVE PARAMETRIC AMPLIFICATION. C.C.Johnson.

J. appl. Phys., Vol. 31, No. 2, 338-45 (Feb., 1960).

A new type of low-noise beam-type parametric amplifier has recently been introduced by Adler, Hrbek and Wade (1958). This device is characterized by its use of the fast-cyclotron wave for amplification purposes instead of the conventionally used slow space-charge wave. The fast-cyclotron wave is selected because it can be made relatively noiseless by appropriate coupling processes. Since the input beam noise is the principal source of noise in beam-type tubes, a very great reduction in noise figure is obtained. Amplification of the fast-cyclotron wave is achieved by use of the parametric principal. An analytical description of the device is presented which includes a discussion of parametric amplification of the fast-cyclotron wave. A method of coupling to cyclotron waves is investigated, and design procedures for establishing optimum low-noise characteristics are outlined.

538.56 : 621.373.42

5399 HOMODYNE DETECTOR FOR REPRODUCTION OF PERIODIC WAVE FORMS. C.Lagercrantz.

J. sci. Instrum., Vol. 36, No. 6, 257-9 (June, 1959).

The principle of homodyne detection is applied to a method of reproducing periodic waveforms in the a.f. range on a pen recorder. The signal is fed to a gate, which is opened by a short reference impulse. The time position of the reference is swept over the signal cycle by aid of a linear phase-shifter, so that all points on the signal curve are consecutively and individually recorded when passed through the gate to an RC filter and finally to the recorder.

538.56 : 621.317.34

5400 MEASUREMENT OF EQUIVALENT NOISE RESISTANCE OF A NOISE THERMOMETER AMPLIFIER. H. Pursey and E.C.Pyatt.

J. sci Instrum., Vol. 36, No. 6, 260-4 (June, 1959).

A method is described for the measurement of amplifier noise to an accuracy of better than 1%. The method involves the determination of the ratio of noise due to the amplifier alone, and the noise due to the amplifier and a wire-wound resistance at a standard temperature. Random errors are analysed, and the effects of symmetric errors are discussed. The work described forms the first stage in the development of a "Noise Thermometer" for absolute measurement of temperature.

538.56 : 535.31 : 621.396.677.81

5401 GENERALIZATIONS OF SPHERICALLY SYMMETRIC LENSES. S.P.Morgan.

I.R.E. Trans Antennas and Propagation, Vol. AP-7, No. 4, 342-5 (Oct., 1959).

The solutions of some spherically symmetric lens and lens-reflector problems recently treated by Kay are generalized. The original problem was to find a variable-index structure, with a point source at its surface or at infinity, which would produce a beam of finite angular width, having a prescribed variation of intensity with angle. It is shown that a prescribed exit beam can be obtained from a point source at any given distance from the lens, and that the index of refraction may be specified more or less arbitrarily in the outer part of the lens. A special case is solved in terms of tabulated functions.

538.56

5402 THE DIFFRACTION OF ELECTROMAGNETIC WAVES. R.King.

Z. angew. Phys., Vol. 12, No. 2, 88-95 (Feb., 1960). In German.

In order to obtain a fuller understanding of the physical significance of the diffraction and scattering of waves by obstacles, a detailed analysis is made of the field in the vicinity of a solid cylindrical conductor with plane incident waves. V.G.Welsby

538.56

5403 DIFFRACTION BY AN IMPERFECTLY CONDUCTING HALF-PLANE AT OBLIQUE INCIDENCE. T.B.A.Senior.

Appl. sci. Res. B, Vol. 8, No. 1, 35-61 (1959).

The exact solution is obtained for the problem of a plane wave incident at an oblique angle on a half-plane of large but infinite conductivity. The usual approximate boundary conditions are applied and lead to coupled Wiener–Hopf integral equations from which to determine the currents excited on the surface of the sheet. The resulting expressions for the field components are found to be entirely different from those which would have been obtained by applying the technique used for the derivation of three-dimensional solutions in the case of perfectly conducting structures, and, indeed, not one component is given to the required accuracy by this technique.

538.56

5404 COMMENTS ON FAR FIELD SCATTERING FROM BODIES OF REVOLUTION.

K.M.Siegel, R.F.Goodrich and V.H.Weston.

Appl. sci. Res. B, Vol. 8, No. 1, 8-12 (1959).

Extends the work of Abstr. 4847 (1959). Rayleigh and resonance scattering for a cone are discussed. Two minus sign errors are corrected in the cone's cross-section obtained by the local wedge-field approximation.

538.56

5405 COMMENTS ON A PAPER "THE SCATTERING OF ELECTROMAGNETIC WAVES BY A CORRUGATED SHEET" BY T.B.A. SENIOR. L.B.Felsen.

Canad. J. Phys., Vol. 37, No. 12, 1563-65 (Dec., 1959).

It is shown that Senior's formula (Abstr. 9877 of 1959) for the amplitude of scattered waves can be deduced from results available in the theory of infinite gratings. Scattering coefficients are derived and shown to agree exactly with Senior's expansions.

A.E.Karbowiak

538.56

5406 TRANSMISSION COEFFICIENT FOR A SYSTEM OF PARALLEL SLITS IN A THIN, [PERFECTLY CONDUCTING] PLANE SCREEN. K.Særmark.

Appl. sci. Res. B, Vol. 8, No. 1, 29-34 (1959).

Some numerical results are given. The electric field vector is polarized along the slit axes.

538.56

5407 PHASE CHANGE ON TRANSMISSION OF MICROWAVES THROUGH METAL DISC DELAY DIELECTRICS.

C.Dhanalakshmi and S.K.Chatterjee.

Z. Phys., Vol. 158, No. 2, 196-203 (1960).

Expressions for the phase change ϕ suffered by microwaves when transmitted through an artificial dielectric composed of metallic disks arranged in a three-dimensional array are derived using three different approaches: molecular theory, electromagnetic theory and transmission line theory. The phase change depends on the distance t that the wave traverses inside the dielectric and also the spacing d between the centres of any two adjacent disks in the three principle directions. Molecular theory indicates ϕ as an increasing function of t, whereas the other two theories indicate ϕ as an oscillatory function of t. The transmission line theory also exhibits ϕ to be real or imaginary depending on t. Experimental values of ϕ as a function of t have been obtained with the help of a microwave (3.2 cm wavelength) interferometer for two dielectrics having d = 1.91 and 2.22 cm, respectively.

538.56 : 621.371

5408 THE DEPENDENCE OF REFLECTION ON INCIDENCE ANGLE. R.Redheffer.

I.R.E. Trans Microwave Theory and Tech., Vol. MTT-7, No. 4, 423-9 (Oct., 1959).

A lossy dielectric sheet has complex dielectric constant $\epsilon = \epsilon(\chi)$ and complex permeability $\mu = \mu(\chi)$, where χ is the distance to one interface. This sheet is backed by a conducting surface and used as an absorber. If $|\kappa(\chi)\mu(\chi)| \gg \epsilon_0\mu_0$, so that $(\epsilon/\epsilon_0)(\mu/\mu_0) - \sin^2\theta$ is nearly independent of the incidence angle θ, then the amplitude reflection $R(\theta)$ is wholly determined by $R(0)$. Typical results: when $R(\theta_0) = 0$ at one polarization, then at $\theta = \theta_0$ the reflection for the other polarization corresponds to a voltage standing-wave ratio = $\sec^2\theta_0$. At perpendicular polarization max $|R(\theta)|$ on (θ_1, θ_2) is least, for given $|R(0)|$, if R(0) is real and positive; and then $R(\theta) = 0$ at $\tan^2\theta/2 = R(0)$. But for parallel polarization R(0) must be real and negative to get optimum performance. When the absorber functions at both polarizations the best obtainable result is $|R(\theta)| = \tan^2\theta/2$, no matter what interval (θ_1, θ_2) is specified. The error in the approximation is investigated theoretically and experimentally. A complete set of graphs is included, suitable for design of those absorbers to which the theory applies. The analysis also yields an exact expression for the limiting behaviour of the reflection at grazing incidence. This can be used in problems such as computation of the field due to a dipole over a plane earth. The theory of the Salisbury screen is re-examined as an aid in checking the other developments.

538.56

5409 ABSORPTION AND REFLECTION SPECTRUM OF A PLASMA. W.D.Hershberger.

J. appl. Phys., Vol. 31, No. 2, 417-22 (Feb., 1960).

A series of absorption and reflection peaks for plasmas, cylindrical in form, and occurring at electron densities lower than that required for the conventional plasma frequency has been reported by various workers such as Tonks (1931), Rommel (1951), and Dattner (1957). This paper describes experiments at a wavelength of 10 cm in which the multiple resonances are observed both within a waveguide and in free space. The electric field of the incident microwave is perpendicular to the axis of the plasma column. The positions of the absorption peaks are given by the interference-dispersion relationship,

$$2n/(2n + 1) = [1 - (f_0/f)^2]^{1/2}.$$

The mode spectrum is found by assigning integral values, including zero, to n. When n = 0, the conventional plasma frequency f_0 is obtained, but for $n > 0$, the frequencies, and electron densities for higher order modes are obtained. The relationship identifies a distinctive set of ratios between the phase velocity of a plasma wave and the r.m.s. velocity of the electrons such that simultaneously the conditions are met for the existence of a standing plasma wave and a stationary pattern of electron motion. Application of the relationship to radar echoes from meteor trails is indicated.

538.56 : 537.56

5410 REFLECTION OF ELECTROMAGNETIC WAVES FROM A PLASMA MOVING IN SLOW-WAVE GUIDES.

O.G.Zagorodnov, Ya.B.Fainberg and A.M.Egorov.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 7-9 (Jan., 1960). In Russian.

An experimental investigation of electromagnetic wave reflection from a moving plasma was carried out. It was found that with the wave greatly slowed down [(1/200) – (1/375)c] the double Doppler effect observed in reflection increases the frequency by 11-20%. The measurements were made at 24.75 Mc/s. A spiral was used as the delaying system. This effect can be utilized for microwave amplification, frequency multiplication, improvement of plasma dynamic stability and measurements in plasma.

538.56 : 621.396.677.75

5411 THE LAUNCHING OF SURFACE WAVES BY A PARALLEL PLATE WAVEGUIDE.

C.M.Angulo and W.S.C.Chang.

I.R.E. Trans Antennas and Propagation, Vol. AP-7, No. 4, 359-68 (Oct., 1959).

The excitation of the lowest TM surface wave in grounded

dielectric slab by a terminated parallel plate waveguide is discussed. The ground plane is the continuation of the lower plate of the waveguide and the infinite dielectric slab is partially filling the waveguide. The thickness of the slab, the height of the parallel plate waveguide, and the frequency are such that only the lowest slow wave can propagate in the partially filled waveguide and the grounded dielectric slab. The Fourier transform of the field scattered by the termination of the upper plate of the waveguide is found by means of the Wiener–Hopf technique and the far fields obtained by the method of steepest descents. The percentage of power reflected back into the waveguide, of power transmitted to the surface wave in the slab, and of power radiated into the open space are plotted v. the thickness of the slab for different heights of the waveguide and $\epsilon = 2.49$. This method of excitation is found to be very efficient. If the dimensions of the waveguide and the slab remain within a considerably wide range, the efficiency obtained for a given frequency is very close to the optimum. Therefore, the adjustments for maximum efficiency are not critical.

538.56 : 621.396.677.75

5412 CLOSELY-SPACED TRANSVERSE SLOTS IN RECTANGULAR WAVEGUIDE. R.F.Hyneman.
I.R.E. Trans Antennas and Propagation, Vol. AP-7, No. 4, 335-42 (Oct., 1959).

The travelling-wave modes associated with an infinite, periodic structure are considered. An approximate equation for the propagation constants of these modes is derived through the use of Fourier analysis and an approximate application of the reaction concept. In the homogeneous case considered, it is found that two dominant modes may exist: an attenuated fundamental mode representing a perturbation of the dominant mode of a closed rectangular waveguide, and an unattenuated surface wave, which is similar to the wave associated with a corrugated surface waveguide. By means of the appropriate variation of physical parameters, including the slot length and spacing, essentially independent control of the attenuation constant and phase velocity of the fundamental mode is possible over a wide range. Typical curves of the propagation constant in terms of these parameters are given, and the results of experimental measurements are shown to be in close agreement with the theory.

538.56 : 621.396.677.75

5413 LEAKY-WAVE ANTENNAS. I. RECTANGULAR WAVEGUIDES. L.O.Goldstone and A.A.Oliner.
I.R.E. Trans Antennas and Propagation, Vol. AP-7, No. 4, 307-19 (Oct., 1959).

A microwave network approach is employed for the description and analysis of leaky-wave aerials. This approach is based on a transverse resonance procedure which yields the complex propagation constants for the leaky waves. A perturbation technique is then applied to the resonance equation to obtain results in simple and practical form. These procedures are illustrated by application to a number of practical leaky rectangular waveguide structures. Very good agreement is obtained between theoretical results and measured values.

538.56 : 621.372.8

5414 ORTHOGONALITY RELATIONSHIPS FOR WAVEGUIDES AND CAVITIES WITH INHOMOGENEOUS ANISOTROPIC MEDIA. A.T.Villeneuve.
I.R.E. Trans Microwave Theory and Tech., Vol. MTT-7, No. 4, 441-6 (Oct., 1959).

A modified reciprocity theorem forms the basis of development of orthogonality relationships for modes in waveguides and in cavities containing inhomogeneous, anisotropic media. In the lossless case certain of these may be interpreted in terms of power flow and energy storage. The special case of magnetized gyrotropic media is discussed for longitudinal and transverse magnetization.

538.56 : 621.372.831

5415 ON THE PERIODIC COUPLING OF PROPAGATING STRUCTURES. N.Rynn.
I.R.E. Trans Electron Devices, Vol. ED-6, No. 3, 325-9 (July, 1959).

An analysis of two propagating structures periodically coupled together, based on a method developed by Pierce (see Abstr.4747 of 1954) is presented. A periodic structure that supports a backward wave may be coupled to a structure that supports a forward wave by coupling to alternate cells of the former. The coupling is completely analogous to the case of continuously coupled waves; i.e., energy is transferred back and forth between the two guides periodically and the period of the transfer is inversely proportional to the strength of the coupling. The period of the transfer is also a function of the number of couplers per unit length. A method of measuring the coupling coefficient is presented and application to a coupled-structure attenuator is discussed.

538.56 : 621.396.674.3

5416 THE CONDUCTANCE OF DIPOLES OF ARBITRARY SIZE AND SHAPE. K.Fränz and P.A.Mann.
I.R.E. Trans Antennas and Propagation, Vol. AP-7, No. 4, 358-8 (Oct., 1959).

The real part of either the impedance or the admittance of dipoles of arbitrary size and shape can be computed rigorously without solving a boundary value problem of a partial differential equation. In analogy to a well-known method of potential theory, fields of standing waves can be generated by integrals over current filaments so that for a given frequency there exist dipole shaped surfaces normal to the electric field surrounded by distant surfaces of vanishing electric field strength. Boundaries of perfect conductors may be supposed to coincide with a dipole shaped surface and a distant closed surface. The transients of such fields of standing waves are intimately related to the steady state of the free radiating dipole, since, before the first waves reflected from the distant enclosure have come back, the dipole cannot know whether or not it is enclosed. Corresponding to the type of current filament, either the resistance, or the conductance, of the radiating dipole can be calculated by direct integrations, while the shape of the dipole is determined by an ordinary differential equation of first order. As an example, a family of dipoles that all have the same conductance, $G = (254\ \Omega)^{-1}$ and a length 2h between limits $\lambda/2 \leq 2h \leq 1.36\ \lambda/2$ is calculated.

538.56 : 621.396.677.5

5417 RADIATION PROPERTIES OF A THIN WIRE LOOP ANTENNA EMBEDDED IN A SPHERICAL MEDIUM. O.R.Cruzan.
I.R.E. Trans Antennas and Propagation, Vol. AP-7, No. 4, 345-52 (Oct., 1959).

Formulae for certain radiation properties of a spherical aerial are derived theoretically. The aerial, which consists of a spherical medium, such as ferrite, with a thin wire loop embedded just below the surface in an equatorial plane, is driven by a slice generator. For the spherical medium, the permeability K_μ and the dielectric constant K_ϵ are assumed to be scalars and, in general, complex. The solutions are facilitated through the expansion of the fields in terms of characteristic orthogonal spherical-vector wave-functions. The properties for which formulae are derived are current distribution, input impedance, input power, radiated power, power loss in the spherical medium, and the efficiency of the aerial. For radiation resistance, not only the general case formula but also the formula for electrically small aerials is given, and the difference between these formulae, for media assumed lossless, is shown graphically.

538.56 : 621.369.677

5418 RANDOM ERRORS IN APERTURE DISTRIBUTIONS. R.H.T.Bates.
I.R.E. Trans Antennas and Propagation, Vol. AP-7, No. 4, 369-72 (Oct., 1959).

The effects of random manufacturing errors on polar diagrams of aerials are analysed in terms of the radius of correlation and mean square magnitude of the errors. The basis of the method is the Wiener–Khintchine theorem. Approximate general formulae are given for the reduction in gain and lowest probable side-lobe level. The implications of the theory are discussed.

538.56

5419 APPROXIMATE CALCULATIONS RELATING TO THE Γ-FUNCTION AND TO WEBER'S EQUATION. APPLICATION TO A PLANE ELECTROMAGNETIC WAVE WHICH PROPAGATES ACROSS AN IONIZED LAYER. R.Meynieux.
Ann. Telecomm., Vol. 14, No. 11-12, 262-76 (Nov.-Dec., 1959). In French.

The paper is concerned with a pure mathematical discussion of a method of approximation to the odd and even solutions of Weber's equation using the Stirling approximation to the Γ-function. The errors involved are critically assessed and forms of solution are evolved which are suitable for calculation purposes, in cases where neither are the rigorous solutions convenient, nor are the usual asymptotic expansions valid. It has been shown that wave propagation in an ionized layer in which the electron density varies parabolically with height is described by a Weber equation (see Abstr. 244 of 1958) and the approximations considered are applied to the solution of this problem. G.D.Sims

538.56 : 621.391.812.63

5420 AN IONOSPHERIC RAY-TRACING TECHNIQUE AND ITS APPLICATION TO A PROBLEM IN LONG-DISTANCE RADIO PROPAGATION. D.B.Muldrew.
I.R.E. Trans Antennas and Propagation, Vol. AP-7, No. 4, 393-6 (Oct., 1959).

A method is given for the determination of the equation of a ray path in a known ionosphere where there are no horizontal gradients. It can partially take into account the effects of the magnetic field of the earth. The method was applied to an oblique path between Ottawa and Slough(5300 km) to determine certain properties of the one-hop mode. From this it is shown that at times one-hop direct-ray propagation is possible over this path.

538.56

5421 RAY PATHS IN THE IONOSPHERE. APPROXIMATE CALCULATIONS IN THE PRESENCE OF THE EARTH'S MAGNETIC FIELD. J.E.Titheridge.
J. atmos. terrest. Phys., Vol. 14, No. 1-2, 50-62 (April, 1959).

Expressions are derived from which it is possible to plot approximate ray paths through "linear" or "parabolic" ionospheric layers in the presence of the earth's magnetic field. From derived curves it is possible to compute simply the horizontal displacement of the reflection point for any dip angle, and for vertical or oblique incidence.

538.56

5422 OBSERVATIONS OF ABNORMAL V.H.F. RADIO WAVE ABSORPTION AT MEDIUM AND HIGH LATITUDES. G.C.Reid and C.Collins.
J. atmos. terrest. Phys., Vol. 14, No. 1-2, 63-81 (April, 1959).

A study of cosmic noise absorption at a frequency of 30 Mc/s at Ottawa and Churchill has revealed the existence of two apparently distinct types of abnormal absorption event. One of these is predominantly a night-time pheomenon and is closely associated with auroral and geomagnetic disturbance. It is suggested that this absorption may be caused by an increase in electron collisional frequency at E-region heights rather than by a large increase in electron density at lower levels. The second type of absorption is confined to the auroral zone and is predominantly a daytime phenomenon, recurring for several days after a large solar flare. Evidence is presented to show that this absorption is due to an increase in ionization at very low levels in the ionosphere. The cosmic noise measurements are supported by evidence from a number of v.h.f. forward-scatter circuits in Canada, and this is used to obtain information about the geographical extent and frequency of occurrence of these abnormal absorption events.

538.56 : 621.391.812.63

5423 MEASUREMENT OF THE IONOSPHERIC ABSORPTION ON 2.5 MC/S AT AHMEDABAD. J.S.Shirke.
J. Instn Telecomm. Engrs (New Delhi), Vol. 5, No. 3, 115-20 (June, 1959).

Measurements were carried out at Ahmedabad (latitude 23°0' N, longitude 72°6' E) using pulsed vertical transmission from August 1957 to July 1958. The strength of the transmitted signal was kept constant and the intensities of the vertically reflected pulses were reduced by the use of a passive attenuator so as to give constant intensity of signal on the oscilloscope screen of the receiving circuit. It was found that mean monthly values of the absorption plotted against $\cos\chi$ for each month from August 1957 to July 1958 obeyed a relation of the type $\log\rho \propto \cos^n\chi$. The value of "n" for individual months ranges from 0.64 to 0.89 and the mean value is 0.73. To eliminate the effects of seasonal changes in the noon zenith distance of the sun, values of absorption for $\cos\chi = 1$ were obtained by extrapolation. These extrapolated values show fairly correlation with the sunspot number. Generally, maximum absorption is reached some time after local noon, suggesting relaxation time for the D region. Absorption larger than that expected by the $\cos\chi$ law is observed in the late evening hours. This is attributed to a contribution from the deviative type of attenuation in the E layer.

538.56 : 621.391.812.63

5424 IONOSPHERIC IRREGULARITIES AND PROPAGATION AT FREQUENCIES ABOVE THE "CLASSICAL" M.U.F. A.K.Saha.
J. Instn Telecomm. Engrs (New Delhi), Vol. 5, No. 3, 136-9 (June, 1959).

Sweep-frequency pulse measurements, carried out elsewhere, have shown that the maximum usable frequency via the F1 and F2 layers may be extended by an anomalous mode of propagation. The extension may be 10-15% above the value calculated from classical theory and is observed only during daytime. It is absent at night. The phenomenon has been ascribed by some authors to scattering by irregularities present in the reflecting layers. Attention is drawn in this connection to the weak short-wave reflections observed at vertical incidence from heights below the normal E layer. These reflections are obtained during daytime and the reflecting layer merges during nighttime with the meteoric E layer responsible for v.h.f. forward scatter propagation. It is argued that the extension of the "classical" m.u.f. may be due to scattering produced by irregularities responsible for the above weak reflections. It is possible that a part of the energy enters the skip zone due to forward scatter during the upward and downward path of the wave through the region containing the irregularities.

538.56 : 621.391.827.42

5425 IONOSPHERIC SELF-DEMODULATION AND SELF-DISTORTION OF RADIO WAVES. J.W.King.
J. atmos. terrest. Phys., Vol. 14, No. 1-2, 41-9 (April, 1959).

Experiments in which the phenomenon of ionospheric self-demodulation was investigated are described. Demodulation is observed to occur only at the lower modulation frequencies, and it is concluded that the occurrence of the phenomenon can be satisfactorily explained by an extension of Bailey's theory of ionospheric cross-modulation as presented by Huxley and Ratcliffe [Abstr. 3774 B of 1949; Proc. Instn Elect. Engrs. Pt III, Vol. 96, 433-40 (Sept., 1949)]. The magnitude of the observed demodulation effect agrees with the value predicted by theoretical considerations and is what would be expected in view of results obtained in cross-modulation experiments. Complications due to selective fading were not present in the experiments performed. It is found that self-demodulation decreases as does ordinary cross-modulation, near dawn; this is explained by the fact that the absorption of the radio wave occurs at a level where the collision frequency is of the same order of magnitude as the equivalent angular frequency of the wave.

538.56 : 621.391.812.63

5426 SOME INVESTIGATIONS ON LONG-WAVE PROPAGATION. S.N.Mitra.
J. Instn Telecomm. Engrs (New Delhi), Vol. 5, No. 3, 121-36 (June, 1959).

Describes some experimental observations on propagation at 164 kc/s from Radio Tashkent (42°N, 69°E) to Delhi (28°35' N, 77°5'E) over a distance of 1650 km. The amplitude of the received wave was continuously recorded at Delhi. The recordings show well-defined sudden increases in amplitude (and gradual fall) coincident with solar flares. The data from 9 August to 16 December 1958 were analysed and 144 instances of sudden increase observed during the period. It is found that flares of all classes of importance give rise to sudden increases in amplitude (s.i.l.). The times of beginning and maximum of these two events agree fairly well (within 5 to 10 min). The variation of H_α line width during a flare is also well correlated, in some instances, with the change in amplitude of the corresponding s.i.l. The height of reflection of this obliquely incident long wave is determined from sunrise effect and is 65 km. The usefulness of s.i.l. as a flare patrol and in short-term forecasting of s.i.d. is discussed.

538.56:621.396.933.2 : 621.391.812.63

5427 THE EFFECTS OF IONOSPHERIC IRREGULARITIES AND THE AURORAL ZONE ON THE BEARINGS OF SHORT-WAVE RADIO SIGNALS. H.A.Whale.
J. atmos. terrest. Phys., Vol. 13, No. 3-4, 258-70 (Feb., 1959).

The nature of the observed variations in the received bearing of the signals from short-wave radio stations at various distances is discussed and the origins of some of the effects are suggested. The major part of the daily variation of bearing of stations up to about 15 000 km distant arises from the refraction of the ray in the F1-region when it is reflected from the F2-region. A discussion of the curving of the ray path by successive small changes of direction at each reflection point leads to the concept of an antipodal area replacing the geometrical antipodal point. The large changes in direction associated with the passage of a ray through the auroral regions suggest a method of plotting the shape of the absorbing parts of the auroral zone by observations at a place remote from this zone. A sample plot obtained by this method is presented.

Radiofrequency Spectroscopy Techniques

538.56

5428 NEW METHOD FOR THE MEASUREMENT OF MICROWAVE INTEGRATED LINE INTENSITIES AND LINE WIDTHS. A.Dymanus, H.A.Dijkerman and G.R.D.Zijderveld.
J. chem. Phys., Vol. 32, No. 3, 717-23 (March, 1960).

A method is described for the measurement of microwave line widths and integrated intensities with Stark-modulation spectrometers. The method makes use of a property that the peak intensity $\alpha_{max,meas}$, measured at a given Stark field E, depends, under certain conditions, only on the half-width α and the peak intensity α_{max}. In the present investigation, the method has been used with a Stark cavity spectrometer employing "antimodulation" techniques which were described in an earlier paper. Experimental procedure, and the possibilities of the method are illustrated by measurements on two lines arising from the $J = 1 \rightarrow 2$ rotational transition of the $O^{16}C^{13}S^{32}$ molecule in the ground state, and in the excited bending-vibrational state (l-doublet). The measured integrated intensity of the ground-state line of $(103 \pm 3.5)10^{-9}$ cm^{-1} sec^{-1} at 1 mm Hg agrees well with the theoretical value of 101.5×10^{-9} cm^{-1} sec^{-1}. The half-width constant of the ground-state line and of the l-doublet line was found to be 6.27 ± 0.18 and 6.17 ± 0.23 Mc/s per mm Hg, respectively. From the measurements on the various mixtures of OCS and N_2, a value of 4.36 ± 0.12 Mc/s per mm Hg was obtained for the collision broadening factor for OCS molecules with N_2 molecules. The present method is applicable to sharp (also weak) lines of which the Stark splitting pattern is quantitatively known.

538.56

5429 SIDE-BAND SUPPRESSION FOR SELF-QUENCHED SUPERREGENERATIVE SPECTROMETERS. V.Rehn and C.Dean.
Rev. sci. Instrum., Vol. 31, No. 1, 72-3 (Jan., 1960).

This is achieved by feeding the very variable signal through a variable-gain (AGC) amplifier, a circuit of which is given.
A.Sczaniecki

538.56

5430 NUCLEAR SPIN PULSE APPARATUS. K.Luszczynski and J.G.Powles.
J. sci. Instrum., Vol. 36, No. 2, 57-63 (Feb., 1959).

A detailed description including circuits and operating instructions, is given for the construction of a nuclear spin pulse apparatus which will measure nuclear spin–lattice relaxation times from 500 μs upwards and nuclear spin–spin relaxation times from 20 μs upwards over the temperature range −180°C to 220°C with an accuracy better than ±5%. All published circuit diagrams and technical data suitable for spin echo apparatus are listed.

538.56

5431 HIGH-RESOLUTION N.M.R. SPECTROMETER WITH THE RADIO FREQUENCY CONTROLLED BY THE MAGNETIC FIELD. R.Freeman and R.V.Pound.
Rev. sci. Instrum., Vol. 31, No. 2, 103-6 (Feb., 1960).

A practical spectrometer for the observation of high-resolution proton magnetic resonance spectra at 30 Mc/s is described. Field modulation is imposed in such a way that "sideband" responses are observed, and this enables lock-in detection to be used, giving increased stability to the baseline of the records. Spectra are displayed by slowly sweeping the modulation frequency and thus are calibrated directly in frequency. The radio-frequency source is a proton controlled super-regenerative oscillator, whose frequency follows variations of the electromagnet field. This reduces the effects of field drift and instability, allowing relatively slow scanning speeds to be used in recording the spectra.

538.56

5432 NUCLEAR RESONANCE STABILIZED BY A MAGNETIC FIELD. D.W.Feldman.
Rev. sci. Instrum., Vol. 31, No. 1, 72 (Jan., 1960).

Describes an electrical feedback system for locking a nuclear magnetic resonance oscillator to a resonance signal thus enabling a magnetic field to be monitored by monitoring the oscillator frequency.
R.C.Glass

538.56

5433 NUCLEAR RESONANCE IN WEAK MAGNETIC FIELDS. NUCLEAR AMPLIFIERS. S.Wilking.
Z. Phys., Vol. 157, No. 3, 384-400 (1959). In German.

A method is described of detecting proton magnetic resonance effects in fields as low as 10^{-6} gauss by using a flowing liquid with suitably long relaxation times (water) and employing prepolarizing and detecting high intensity (10^4 gauss) magnetic fields. By causing magnetization reversal in the weak field a form of nuclear amplifier is produced.
J.G.Powles

538.56 : 621.372.413

5434 PLASTIC MICROWAVE CAVITIES FOR E.P.R. P.F.Chester, P.E.Wagner, J.G.Castle and G.Conn.
Rev. sci. Instrum., Vol. 30, No. 12, 1127-8 (Dec., 1959).

Describes an X-band, TE_{10n} cavity made in epoxy resin (Hysol 6000 C-8). The material is strong, machines well and does not become brittle at liquid helium temperatures.
A.H.W.Beck

NUCLEAR AND ATOMIC PHYSICS

APPARATUS . PARTICLE DETECTORS

539.1.07

5435 ON THE EFFECT OF VAPOURS ON THE GEIGER POINT COUNTER. A.Hrbek.
Czech. J. Phys., Vol. 9, No. 1, 127-8 (1959). In German.

A very brief summary of experimental conclusions. Various quenching vapours etc. are mentioned, and their effect on counter characteristics.
J.D.Craggs

539.1.07

5436 MEASUREMENT OF THE EFFECT OF A SIMPLE PASSIVATION PROCESS FOR ORGANIC VAPOUR GM COUNTERS. E.Gatti, G.Redaelli and R.Renzoni.
Energia nucleare, Vol. 7, No. 1, 23-30 (Jan., 1960).

A simple method for the cathode passivation of GM counters is described. This method of treating nullifies permanently the photoelectric sensitivity, in the visible spectrum, of the GM counters. Measurement and evaluations of comparison between the treated and the non-treated counters have been effected.

539.1.07

5437 TRANSISTORIZED AREA MONITOR USES G-M–ION-CHAMBER PROBE. H.A.Brown and J.V Rogers.
Nucleonics, Vol. 17, No.8, 88-90 (Aug., 1959).

At low radiation levels a halogen-quenched counter operates as a G-M counter triggering a transistor multivibrator. The output is rectified and added to the mean current from the counter which acts as an ionization chamber at higher levels. The system has a logarithmic response from 0.1 mr/hr to 10 r/hr and incorporates up to 10 monitor probes feeding a central station.
R.D.Smith

539.1.07 : 537.533 : 621.387.424

5438 THE WORK FUNCTION OF CATHODES FOR ELECTRONS AND THE PERFORMANCE CHARACTERISTICS OF GEIGER-MÜLLER COUNTING TUBES. O.Orient.
Acta phys. Hungar., Vol. 7, No. 2, 199-206 (1957).

The relation is investigated between the work function of counting-tube cathodes and the performance characteristics of the tubes. The cathode materials are Zn, Cd, Cu, and Ni. The results show that for counting tubes of identical geometry and filled to the same pressure, the plateau is longer and its slope lower for tubes with cathodes characterized by larger work functions. For identical overvoltages, the electric charge liberated per count is proved to be the same in counting tubes with different cathodes. It follows that, other conditions being equal, the number of ions per discharge is independent of the material of the cathode.

539.1.07

5439 MEASUREMENT OF THE QUANTUM EFFICIENCY OF A PROPORTIONAL COUNTER USING X-RAYS. A.E.Kiss and N. Patla.
Brit. J. appl. Phys., Vol. 10, No. 8, 376-80 (Aug., 1959).

The variation of quantum efficiency with X-ray wavelength and

beam direction is investigated in the range 0.2 - 2.3 A. Measurement, in the same range, of the absorption coefficient for the counter-window material (Pyrex) is described. The counter used shows a maximum efficiency of about 70% at 1.4 A, decreasing on either side of this wavelength. Proper choice of beam direction within the counter is required if a useful efficiency is to be obtained at the shorter wavelengths. The effects of counter geometry and construction, scattering processes and fluorescence on the quantum efficiency are briefly discussed.

539.1.07

5440 EFFECTS OF REACTOR EXPOSURE ON BORON-LINED AND BF_3 PROPORTIONAL COUNTERS.
W.M.Trenholme.
I.R.E. Trans Nuclear Sci., Vol. NS-6, No. 4, 1-7 (Dec., 1959).

The results of reactor exposure on the characteristics of several types of boron-lined and BF_3-filled proportional counters are presented, and the important design and application criteria that lead to improved performance of counters after long reactor exposure are discussed.

539.1.07

5441 A COMPACT FREE-AIR CHAMBER FOR USE IN THE RANGE 10–50 kV. J.R.Greening.
Brit. J. Radiol., Vol. 33, 178-83 (March, 1960).

A free-air chamber is described which embodies a new field-guarding method, due to Kemp (Abstr.2349 of 1957). A compact design is achieved which facilitates the use of the chamber for the direct measurement of "in-air" outputs of X-ray units operated under clinical conditions. The design factors of the instrument and its performance are discussed.

539.1.07

5442 DESIGN OF FREE-AIR IONIZATION CHAMBERS FOR THE SOFT X-RAY REGION (20-100 kV). V.H.Ritz.
Radiology, Vol. 73, No. 6, 911-22 (Dec., 1959).

The paper discusses corrections due to: (a) distortion of the electric field in the collecting region by the guard-strip system, (b) the range of primary electrons ionizing within the chamber sensitive volume, (c) the scattered photon contribution, and (d) air attenuation; particularly important in the soft X-ray region. The results of these corrections are shown graphically. The sum of the maximum uncertainties due to these factors yield a probable limit of error of ± 0.5% in the determination of exposure dose in the soft X-ray region. The work was undertaken to provide design criteria for 20-100 kV X-radiation dose measurement with filtration ranging from 2 mm of Be to that plus 4 mm of Al. I.C.Demetsopoullos

539.1.07

5443 CONSTRUCTION OF BORON IONIZATION CHAMBERS. A.B.Dmitriev, M.G.Vorob'ev, L.G.Kosmarskaya and N.I.Chipurenko.
Pribory i Tekh. Eksper., 1959, No. 3, 59-62 (May-June). In Russian.

Three types of boron counters of Soviet manufacture are described. The three types are: KN (BF_3 filled), KNT (electrodes coated with amorphous boron) and KNK (similar to KNT but with specially low γ-ray sensitivity). The counters are used in reactor work. S.Chomet

539.1.07

5444 CHARACTERISTICS OF IONIZATION CHAMBERS FILLED WITH LIQUID HEXANE.
D.Blanc, G.Giron, J.Mathieu, M.Ponsan and T.Pujol.
C.R. Acad. Sci. (Paris), Vol. 249, No. 23, 2546-8 (Dec. 9, 1959). In French.

The ionization chamber has parallel plates with variable separation (from 0 to 4 mm) and completely immersed in liquid hexane at room temperature. A beam of Co^{60} radiation parallel to the plane of the electrodes is used. Jaffe's theory holds until the field exceeds 12 000 V/cm. Above this, ionization current continues to increase with increasing field, but no longer linearly, due to an ionic multiplication analagous to the gaseous case. Similar results were obtained with α rays. D.V.Mabbs

539.1.07

5445 GEOMETRICAL CORRECTION FACTOR FOR CYLINDRICAL IONIZATION CHAMBERS.
E.E.Kovalev and V.I.Popov.
Pribory i Tekh. Eksper., 1959, No. 3, 63-6 (May-June). In Russian.

An expression is derived for the correction factor which takes into account the linear dimensions of a cylindrical chamber, particularly when these dimensions are not small compared with the distance from the source. The expression may be used to find the optimum form of a chamber. It is shown that the correction factor is very nearly unity when the length to diameter ratio is 1.19. S.Chomet

539.1.07

5446 LARGE CRYSTAL COUNTING. M.A.Van Dilla.
Nucleonics, Vol. 17, No. 11, 150,152, 155. (Nov., 1959)

The best resolution from 9 in. diameter NaI crystals was obtained using a cluster of 3 in. diameter photomultipliers rather than larger photomultipliers. The radioactive background is, however, proportional to the number of photomultipliers used. R.D.Smith

539.1.07

5447 BACKGROUND vs. EFFICIENCY IN LIQUID SCINTILLATORS. F.R.Domer and F.N.Hayes.
Nucleonics, Vol. 18, No. 1, 100 (Jan., 1960).

The background counting rate and efficiency for suspensions containing C^{14} in a liquid scintillator were measured. The relationship is not linear, so that use of a single background sample for a series of measurements is inaccurate. R.D.Smith

539.1.07

5448 SENSITIVE DETECTOR OF γ-RADIATION IN LIQUID OR GASEOUS EFFLUENTS. J.G.Mitchell.
J. sci. Instrum., Vol. 36, No. 9, 396-8 (Sept., 1959).

The instrument is a plastic-phosphor scintillation-type detector which can be used to monitor the radioactivity of liquid and gaseous effluents. With liquid effluents, it can detect activities of about 1.5×10^{-6} $\mu c/cm^3$ of 0.7 MeV γ-radiation, and for gaseous effluents, 1/280 m.p.c. of A^{41} in air, (maximum permissible concentration = 5×10^{-7} $\mu c/cm^3$). The experimental determination of the optimum sensitivity of the detector system is described and results are given. The system provides a continuous day-and-night record of the activities monitored. Also, it gives automatic warning of dangerously high levels of activity and of a failure in its own electrical system.

539.1.07 : 539.17

SCINTILLATION PROPERTIES OF BaF_2. See Abstr. 4118

539.1.07 : 539.2 : 548.7

USE OF SCINTILLATION COUNTERS IN SINGLE CRYSTAL X-RAY DIFFRACTOMETRY. See Abstr. 4612

539.1.07 : 532.7 : 535.37

NEW LIQUID SCINTILLANT. See Abstr. 5032

539.1.07

5449 HODOSCOPE DESIGN TO MINIMIZE PHOTOMULTIPLIER USE. L.W.Alvarez.
Rev. sci. Instrum, Vol. 31, No. 1, 76 (Jan. 1, 1960).

A design of binary hodoscope is described which greatly reduces the number of photomultipliers needed to determine with prescribed precision the coordinates of incidence of a high-energy particle on a given plane. One binary arrangement discussed, reduces the number of tubes needed to view an 8 × 8 square array from 16 in the normal arrangement, to 6. In another example, designed to give unambiguous results when the particle track is not normal to the plane, the number of tubes needed to view a 16 × 16 array is reduced from 32 to 8. R.E.Meads

539.1.07

5450 SENSITIVE 4π DETECTOR FOR SCANNING RADIOCHROMATOGRAMS. L.L.Salomon.
Science, Vol. 131, 415-17 (Feb. 12, 1960).

In an effort to obtain improved sensitivity in scanning unidimensional radiochromatograms of compounds labelled with weak beta-emitters, a detecting system was devised which simultaneously scans the upper and lower surfaces of the chromatogram. The instrument embodies substantial improvements based on the operation of a prototype.

539.1.07

5451 CORONA COUNTERS FOR HEAVILY IONIZING PARTICLES.
A.B.Dmitriev, Yu.M.Tolchenov, A.I.Filatov and V.G.Chaikovskii.
Pribory i Tekh. Eksper., 1959, No. 3, 35-40 (May-June). In Russian.

Details are given of the construction and characteristics of

counters for heavily ionizing particles, which use neon-argon mixtures and work in a stable corona discharge. The gas multiplication factor, being 10^3-10^4, can be made almost independent of applied potential by use of high load resistance (10^8 ohms). Thus the counter has a long (about 400 V) plateau with a small slope. The amplitude of pulses is proportional to the ionization produced by the particles in the working region of the counter. The presence of high background due to any weakly ionizing radiation has little effect on the counter characteristics, because of the presence of considerable current (10^{-8} A) in a corona discharge. J.M.Zarzycki

539.1.07

5452 THE SHAPE OF ELECTRIC FIELD IN CORONA COUNTERS. Yu.M.Tolchenov.
Pribory i Tekh. Eksper., 1959, No. 3, 40-3 (May-June). In Russian.

Derives field equations for counters used for highly ionizing particles and working in the stable corona discharge (see preceding abstract). The transit times of ions across the counters filled with pure argon and having Ni cathodes were measured in the proportional and in the corona region. Ion mobilities in the region of non-self-sustained discharge were also measured and were found to be between 1.9 and 2.2 $cm^2\ sec^{-1}\ V^{-1}\ atm^{-1}$. Experimental results showed good agreement with the derived equations. J.M.Zarzycki

539.1.07

5453 CERIC DOSIMETRY: ACCURATE MEASUREMENTS AT 10^6 RADS. J.T.Harlan and E.J.Hart.
Nucleonics, Vol. 17, No. 8, 102, 107 (Aug., 1959).

The reduction of ceric ion to cerous ion in ceric sulphate solutions from 0.01 to 0.6 molar was studied for doses up to 10^{25} eV/litre. The ceric ion concentration was measured by titration and the γ-dose calculated by means of ferrous-ferric dosimeter measurements. The dosimeter is non-linear but high accuracy can be achieved by careful calibration. R.D.Smith

539.1.07

5454 CERIC DOSIMETRY: ROUTINE USE AT 10^5-10^7 RADS. S.I.Taimuty, L.H.Towle and D.L.Peterson.
Nucleonics, Vol. 17, No. 8, 103-5, 107 (Aug., 1959).

High purity ceric sulphate solutions with ceric ion concentrations from 0.001 M to 0.05 M were irradiated with Co^{60} γ's and the reduction of ceric ion determined from a measurement of the optical density at 3200 A. The concentration of the dosimeter solution was arranged so that the measured dose will reduce 20-80% of the ceric ion and the irradiation must take place in a vessel large compared with the maximum range of the secondary electrons. Accuracy better than ± 2% can be achieved. R.D.Smith

539.1.07

5455 MEASURING LARGE RADIATION DOSES.
Nucleonics, Vol. 17, No. 10, 57-76 (Oct., 1959).

A survey of current work on methods of measuring large doses of radiation. The following methods are included: (a) Glass dosimetry, depending on measurement of changes of optical absorption or luminescence and covers the range from $1-5\times10^6$ rad. Absorption changes in Ag activated phosphate glass cover the range from 10^3 to 3×10^5 rad. A borosilicate glass showing absorption bands in the near ultra-violet extends the range to 5×10^6 rad. (b) Photographic methods. High dose devices make use of the "printout" effect i.e. photolytic reduction of silver without development. By suitable choice of film doses of 10^4-10^8 rad can be measured. (c) Luminescence degradation. The decrease in luminescence of an organic phosphor after exposure to radiation is measured. A system employing thin wafers of anthracene or p-quaterphenyl covers the range 5×10^5-5×10^9 rads with an accuracy of ± 10%. Other promising materials include small concentrations of quinine in water, diphenyloxazole (PPO) in xylene and plastic scintillators. (d) Changes of physical, chemical or mechanical properties of plastics can also be used for dosimetry. For example, the colour change of PVC can be used in the range from 10^5-10^7 rads, and the polymerization of acetylene to cuprene and benzene as a measure of the irradiation of gases; the change in viscocity of polystyrene, is linearly related to the dose, and several processes which result in gas evolution. (e) Microbial monitors. A dry harmless microorganism is coated onto a plastic film and irradiated. The organism is then cultured on agar gel and the number of surviving colonies counted. (f) Chemical dosimetry. Many chemical reactions can be used for dosimetry and more than 40 methods are listed. These include the Fricke dosimeter using the oxidation of ferrous sulphate, which can be used as a standard, the reduction of ceric sulphate, oxalic acid and chlorinated hydrocarbon systems. Most of the dosimeters described require calibration. The best standards are the Fricke ferrous-ferric dosimeter and calorimetry which serves as primary standard. The design of suitable calorimeters is discussed: accuracy of better than 1% has been achieved for Co^{60} radiation measurements. Dose rate measuring devices include special Faraday chambers. These are designed so that the beam is first absorbed in low Z material to minimise back-scatter. A magnetic field prevents the escape of secondary electrons and ion collection from the surrounding air is eliminated by placing the chamber in a vacuum. Secondary emission chambers measure the current produced by an electron beam passing through a thin foil. Ionization chambers and semiconducting devices can also be used. A comparative table of 24 dosimeter methods and an extensive bibliography are included. R.D.Smith

539.1.07

5456 HEALTH PHYSICS, LABORATORY INSTRUMENTS. J.N.Wilson.
Nucleonics, Vol. 17, No. 12, 86, 88, 90, 92-94, 96. (Dec., 1959).

Instruments developed at the Savannah River Laboratory include the following. (a) A spark counter for detecting α-emitting nuclides spilt on floors. (b) A series of ZnS scintillator monitors. (c) A continuous monitor for airborne plutonium. This depends on separation of natural and artificial radioactivity by use of an impactor. The man-made particles >0.5 μ are impacted on to a tape and carried to a monitor, whilst the natural radioactive particles <0.04 μ are not precipitated. (d) Tritium monitors including an open ended dosimeter for detecting surface contamination. (e) Portable γ and α monitors using cold-cathode tubes. R.D.Smith

539.1.07 : 621.374.32

5457 TRANSISTORISED PORTABLE COUNTING-RATE METER. W.W.Goldsworthy.
Nucleonics, Vol. 18, No. 1, 92, 94, 96, 98, 99 (Jan., 1960).

Full circuit details are given of an α, β, γ-monitor with interchangeable detector probes, operating from a 10 V battery supply. Pulses are fed into a 4-stage transistor amplifier using alternate n-p-n. and p-n-p. transistors and having a gain of ≅ 70 dB. After differentiation they enter a univibrator metering circuit. The monitor includes a stabilized 2 kV h.t. supply generated by a Cockcroft–Walton circuit from a 2 kc/s square wave. R.D.Smith

539.1.07

5458 DUST-TRACK MODEL OF CLOUD CHAMBER AND NUCLEAR EMULSION EVENTS. E.W.Cowan.
Amer. J. Phys., Vol. 27, No. 2, 118 (Feb., 1959).

A description of how a glass plate, evenly sprinkled with chalk dust, may be used to illustrate particle tracks. Lead and/or alnico slugs are used to represent particles. Details are given. E.G.Knowles

539.1.07

5459 SCINTILLATION-BUBBLE CHAMBER. R.C.Minehart and R.H.Milburn.
Rev. sci. Instrum., Vol. 31, No. 2, 173-4 (Feb., 1960).

A solution of 33 g of naphthalene and 133 mg of PBD phosphor in a litre of liquid propane has been found to perform as a liquid scintillation counter at temperatures of 65-75°C. This solution also functions comparably to pure propane as a bubble chamber filling. Scintillations have been obtained from 100-145 MeV protons as well as from minimum-ionizing particles. This precludes Cherenkov radiation as the dominant scintillation mechanism, shows that the processes of scintillation and bubble nucleation are compatible in the propane solution. Using a gated photomultiplier system a number of chamber-scintillation-controlled photographs have been made of cosmic-ray tracks.

539.1.07

5460 THE RANGE–ENERGY RELATION IN AGFA K2 NUCLEAR EMULSION. D.Bebel.
Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 3-4, 144-56 (1960). In German.

The range–energy relation for protons is calculated in Agfa K2 emulsion, in the energy range of 1 to 70 MeV. In excess of 10 MeV the proton range is approximately 10% longer than in Ilford C2 emulsion. S.J.St-Lorant

539.1.07

5461 THE CALCULATION AND CALIBRATION OF A "CONSTANT SAGITTA" SCHEME FOR AGFA K2 NUCLEAR EMULSION. D.Bebel.

Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 3-4, 57-73 (1960). In German.

A constant sagitta cell scheme for singly charged particles is obtained on the basis of Molière's theory of multiple scattering and a range–energy relation for Agfa K2 emulsion. Calibration is provided by protons with residual range between 5 and 10 mm. A possibility of increasing the resolving power of the method is suggested. S.J.St-Lorant

539.1.07

5462 THE PRINCIPLE OF AN ANALYSIS OF COMPLEX EXPERIMENTAL CURVES AND ITS APPLICATION TO THE MEASUREMENT OF THE GRAIN DENSITY OF HEAVILY IONIZING TRACKS IN NUCLEAR EMULSION. W.Paskievici.
Canad. J. Phys., Vol. 37, No. 11, 1314-20 (Nov., 1959). In French.

A mathematical formulation embodying Fourier transforms is considered which facilitates the reduction of complicated experimental curves to components of elementary form. The procedure works when the original curve is derived by superposition of a number of components of the same analytic form but differing in amplitude. The application of the method to photometric curves to determine the grain density of heavily ionizing tracks in nuclear emulsion is illustrated by a simple, idealized example, and its precision discussed. S.J.St-Lorant

539.1.07

5463 USE OF DIAMOND DUST SUSPENSION IN THE STUDY OF NUCLEAR REACTIONS IN CARBON.
A.P.Zhdanov and P.I.Fedotov.
Pribory i Tekh. Eksper., 1959, No. 3, 133 (May-June). In Russian.

A brief note reporting the use of diamond dust suspensions in nuclear emulsions. The technique has been used to study the interaction of protons with carbon nuclei. S.Chomet

539.1.07 : 621.374.32

5464 A COINCIDENCE CIRCUIT FOR SMALL AMPLITUDE PULSES. Yu.K.Akimov.
Pribory i Tekh. Eksper., 1959, No. 3, 134 (May-June). In Russian.

The circuit is such that when a single pulse is fed into it (0.03 - 0.3 V) the output pulse is 0.01 - 0.02 V, while if two coincident pulses in the above range are applied, the output pulse is 2.5 - 50 times greater than either of the input pulses. For input pulses up to 8 V, this ratio can reach a value of 50 - 100. S.Chomet

539.1.07

5465 ON THE DETERMINATION OF THE ENERGY OF A PARTICLE FROM ITS TRACK IN AN EMULSION.
L.Jánossy.
Acta phys. Hungar., Vol. 7, No.4, 385-401 (1957).

Statistical methods are discussed for the determination of the energy of a particle from its track in an emulsion. The maximum possible information can be obtained by applying the maximum likelihood method. The latter is described and it is shown that the somewhat complicated procedure for the determination of the particle energy obtained in this way can be replaced by a very much simpler method which gives only 1% less information than the former. The question of elimination of background noise is not treated.

539.1.07

5466 REVIEW OF FRENCH PROGRESS IN NUCLEAR INSTRUMENTATION. M.Surdin.
Nucleonics, Vol. 17, No. 8, 80-2 (Aug., 1959).

The instruments described include (a) Diffused n–p junctions of germanium used as proportional counters for α-particles. Resolutions of 4% have been obtained with 5 MeV α-particles. Neutron detectors were also made by incorporating boron in the semiconductor. (b) An instrument for detecting leakage of heavy water into light water circuits of the EL3 reactor based on the detection of the 0.51 MeV γ-ray from F^{17} produced by the $O^{18}(d,n)$ reaction. (c) The use of an analogue computer for finding the effects of reactor coolant failure. (d) A special photomultiplier designed for fast rise time, high gain and large pulse output. (e) A scintillator system for detecting plutonium in air which discriminates against the natural Th and Ra activity by detecting coincidences from α and β particles emitted by successive members of the decay chains. (g) A fast system for giving in coded form the time interval between the initial pulse and a random pulse. This system is suitable for time of flight detectors. R.D.Smith

NUCLEAR FIELD THEORY

539.11

5467 ON AN EQUIVALENCE THEOREM FOR INTEGRO-DIFFERENTIAL EQUATIONS OCCURRING IN FIELD THEORIES. K.L.Nagy.
Acta phys. Hungar., Vol. 10, No. 2, 195-8 (1959).

A direct proof is given for the equivalence of two types of integro-differential equation, treated by Kròlikowski and Rzewuski (Abstr. 9409 of 1955; 2968 of 1957). The calculation shows a close connection between the equivalence theorem and the well-known initial value problem.

539.11

5468 REPRESENTATION OF STATES IN A FIELD THEORY WITH CANONICAL VARIABLES.
F.Coester and R.Haag.
Phys. Rev., Vol. 117, No. 4, 1137-45 (Feb. 15, 1960).

The properties of a functional representation of states are investigated for a self-coupled scalar field theory. The assumption is made that all states can be generated by applying functionals of the field at a fixed time (t=0) to the vacuum state. It is shown that for the class of models considered the Hamiltonian is uniquely determined by the vacuum functional. The calculation of scalar products between states leads to functional integrals. The measure in this integration over function space is also determined by the vacuum state. Two methods for the evaluation of the functional integrals are discussed. The first one reduces the problem in some simple cases to the solution of an eigenvalue problem for a Hilbert–Schmidt kernel plus a finite number of ordinary integrations. The other one gives a perturbation series.

539.11

5469 ON ANALYTIC PROPERTIES OF VERTEX PARTS IN QUANTUM FIELD THEORY. L.D.Landau.
Nuclear Phys., Vol. 13, No. 1, 181-92 (Oct. [1], 1959).

A general method of finding the singularities of quantum field theory values on the basis of graph techniques is evolved.

539.11

5470 SOME ANALYTIC PROPERTIES OF THE VERTEX FUNCTION. R.Oehme.
Phys. Rev., Vol. 117, No. 4, 1151-9 (Feb. 15, 1960).

For previous work, see Abstr. 1046, 13009 (1959). The absorptive part of the vertex function $F[k^2,p^2,(k-p)^2]$ is an analytic function of the mass variables k^2 and p^2. On the basis of causality and the spectral conditions, the region of regularity $D(\sigma)$ of the absorptive part $A(k^2,p^2,\sigma^2)$ is obtained for fixed values of $\sigma \geq c$. The boundary of $D(\sigma)$ is calculated explicitly for the case $k^2 = p^2$, which is of interest in connection with form factors. By the use of examples based upon perturbation theory, it is shown that this boundary is characteristic for the physical assumptions that have been made. The intersection D of all domains $D(\sigma)$ for $\sigma \geq c$ is the region for which F is an analytic function of all three variables, with $(k-p)^2$ in the cut plane and (k^2,p^2) in D. The relation of these general results to the composite structure of particles is discussed. A simple, direct representation for the vertex function F is used in order to find limits for the region in the $(k-p)^2$ plane where singularities are allowed by the axioms. For real $k^2 = p^2 = z$, it is shown that the singularities are restricted to a finite region, and the static cut $(k-p)^2 \geq c^2$, provided z is below the onset of the corresponding cut in the z plane.

539.11

5471 THE INTERPRETATION OF QUANTUM MECHANICS. CASE OF THE PRESENCE OF AN ELECTROMAGNETIC FIELD. A.Datzeff.
C.R. Acad. Sci. (Paris), Vol. 249, No. 25, 2725-7 (Dec. 21, 1959). In French.

Using only the energy and momentum relations for the classical motion, a formal generalization of the Schrödinger equation gives the corresponding wave equation for the motion of a charged particle in an electromagnetic field. T.R.Carson

539.11

5472 ON THE CORRESPONDENCE PRINCIPLE IN QUANTUM ELECTRODYNAMICS. G.M.Prosperi and A.Scotti.
Nuclear Phys., Vol. 13, No. 1, 140-9 (Oct. (1), 1959).

The authors start from a simplified version of quantum electrodynamics: charged particles are described by means of a quantized

Schrödinger field $\psi(x, t)$ interacting with a quantized and external electromagnetic field. An operator $q_k(t) = d_x x \vec{x}_k \psi^+ \psi$ is introduced and the time evolution of its expectation value $\langle q_k \rangle = \langle \Psi | q_k | \Psi \rangle$ is studied for a state $|\Psi\rangle$ with only one incoming charged particle and a certain initial condition on the radiation field. Under the assumption that the indeterminacies Δq_k and $\Delta \dot{q}_k$ are negligible and the gradients of the external field are sufficiently small, it is found that $\langle q_k \rangle$ obeys a third-order differential equation which coincides with the classical non-relativistic equation of motion of Lorentz.

539.11

5473 SOME GENERAL RELATIONSHIPS IN STATISTICAL QUANTUM ELECTRODYNAMICS. E.S.Fradkin.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 157-60 (Jan., 1960).
In Russian.

General relationships connected with the gauge invariance of statistical quantum electrodynamics are given.

539.11

5474 GAUGE PROPERTIES OF PROPAGATORS IN QUANTUM ELECTRODYNAMICS. B.Zumino.
J. math. Phys. (New York), Vol. 1, No. 1, 1-7 (Jan.-Feb., 1960).

The effect of a change of gauge on the propagators is studied systematically for quantum electrodynamics. Various gauges are considered, among them the Coulomb, the Landau, the Feynman, and the Yennie gauges. The equivalence of the various formulations of the theory is demonstrated. For the relativistic gauges, the transformation of the wave function renormalization constant is described.

539.11

5475 A SIX-DIMENSIONAL RIEMANNIAN MANIFOLD, ITS APPLICATIONS TO MESO-ELECTRODYNAMICS, AND A SYSTEMATIZATION OF STRONGLY INTERACTING PARTICLES. J.Rayski.
Acta phys. Polon., Vol. 18, No. 4, 371-85 (1959).

A conception of a six-dimensional world enables a geometrical interpretation of the electric charge, charge conjugation, gauge transformations, and of the electromagnetic field. The same conception explains satisfactorily the isospin, its connection with the electric charge, and the ps-scalar character of nuclear forces. Several qualitative and some quantitative properties of strongly interacting particles (strangeness, rest masses, etc.) find an intuitive explanation within this geometrical framework.

539.11

5476 SPACE AND TIME REFLECTIONS IN RELATIVISTIC THEORY. Yu.M.Shirokov.
Nuclear Phys., Vol. 15, No. 1, 1-12 (Feb. [1], 1960).

A complete classification of representations of the inhomogeneous Lorentz group is obtained including space reflections and time reflections of the Wigner type. The problem of the squares of various reflection operations for particles of series-integral spin is investigated in detail. The general results thus obtained are compared with those obtained when superimposing additional requirements on the theory, notably, the requirements of the locality of the field operators.

539.11

5477 TYPES OF SYMMETRY OF ELEMENTARY PARTICLES. Yu.M.Shirokov.
Nuclear Phys., Vol. 15, No. 1, 13-15 (Feb. [1], 1960).

It is shown that five different types of symmetry relative to space–time reflections are possible for elementary particles. The treatment is based only on properties of relativistic invariance and does not depend on locality or any other specific properties of the equations of motion. It is shown that only two types of symmetry are possible for particles with a zero rest mass and a non-zero spin.

539.11

5478 FIELD INTERACTIONS WITH "INVERSION IMAGES". Kuo-Hsien Tzou.
C.R. Acad. Sci. (Paris), Vol. 250, No. 4, 668-70 (Jan. 25, 1960).
In French.

Suggests a seemingly non-local coupling of field operators with coordinates which are "mirror images" under some inversion operator. Derives the V–A four-fermion interaction from such a theory.
R.J.N.Phillips

539.11

5479 SEVEN-DIMENSIONAL CHARGE SPACE. D.C.Peaslee.
Phys. Rev., Vol. 117, No. 3, 873-86 (Feb. 1, 1960).

Some implications of a charge space of seven (rotational) dimensions are considered for (1) particle classification, (2) strong interactions, and (3) weak interactions. The principal conclusions from this point of view are that (1) all particles except the photon and graviton can be incorporated in 7-dimensional charge space; lepton conservation must be abandoned, which automatically introduces parity nonconservation into β-decay; (2) the one boson, two fermion interaction is predominantly pseudovector in form and induces no mass differences; the Σ-Λ mass difference arises from interference with a fundamental two boson, two fermion interaction of lower charge symmetry; the Ξ–N mass difference has an "intrinsic" basis and is not due entirely to strong interactions; (3) the weak universal Fermi interaction has signature –1 under time reversal; the strangeness change $\Delta S = \pm 1$ is associated with 256 independent (in principle) terms; the rule $\Delta I = \pm\frac{1}{2}$ needs further qualification because $I = T + U$, where T and U are independent operators.

539.11

5480 EXACTLY RENORMALIZABLE MODEL IN QUANTUM FIELD THEORY. III. RENORMALIZATION IN THE CASE OF TWO V-PARTICLES. T.W.Ruijgrok.
Physica, Vol. 25, No. 5, 357-64 (May, 1959).

For Pt II, see Abstr. 2773 (1958). A simpler formulation of the renormalized Schrödinger equation is given for the model discussed previously. The renormalization is extended to the case of more than one heavy particle. The final results contain no divergences and are easily visualized in terms of diagrams which are calculated using only the renormalized coupling constants. It is conceivable that this formulation of the theory also applies to more realistic models.

539.11

5481 STRONG AND WEAK INTERACTIONS IN A SIMPLE FIELD-THEORETICAL MODEL. L.van Hove.
Physica, Vol. 25, No. 5, 365-70 (May, 1959).

An exactly renormalizable model of quantum fields, introduced earlier (see Abstr. 2773 of 1958), is considered for large but finite cut-off. It gives rise to strong and weak interaction effects. In the limit of infinite cut-off the weak interactions vanish and the strong interactions obey a certain symmetry law. This symmetry is violated by the weak interactions. It is emphasized that none of these properties is explicitly present in the Hamiltonian of the theory, the form of which could hardly be guessed from the behaviour of the system at energies well below the cut-off.

539.11

5482 INCONSISTENCY OF CUBIC BOSON–BOSON INTERACTIONS. G.Baym.
Phys. Rev., Vol. 117, No. 3, 886-8 (Feb. 1, 1960).

It is shown that there does not exist a ground state for a system of spin zero bose fields coupled only by local interactions involving three powers of the fields. Thus these interactions alone are not suitable for a model of interacting fields.

539.11

5483 MASS REVERSAL AND THE INTERACTIONS OF ELEMENTARY PARTICLES. K.Nagy.
Acta phys. Hungar., Vol. 10, No. 4, 441-8 (1959).

After grouping the fermions into isotopic doublets (n,p), (μ, μ^0), (e,ν), it is supposed that the mass reversal transformations should be carried out simultaneously for the two members of each doublet. It is required that all interactions of the elementary particles should be invariant under the mass reversal transformation and also under the γ_5-transformation for massless particles. This invariance principle in the case of weak interactions chooses the $V \pm A$ interaction, leaving the values of the coupling constants arbitrary. The strong nucleon – π, nucleon – K interactions are also invariant. The supposed strong parity conserving μ – K interaction may be only of four-vector isoscalar type. The possibility of a parity-nonconserving μ – K interaction is also mentioned.

539.11

5484 STRONG INTERACTIONS IN THE FOUR-DIMENSIONAL ISOTOPIC SPACE. F.Károlyházy and G.Marx.
Acta phys. Hungar., Vol. 10, No. 4, 421-8 (1959).

A new variant of the mathematical scheme in the four-dimensional isotopic spin space is proposed, which is suited to investigate and consider the relations found by Gell-Mann and others. Nucleons, hyperons of order one and hyperons of order two are described by spinor quantities B_α, $B_{\alpha\dot{\alpha}}$ and $B_{\alpha\dot{\alpha}\tau}$, respectively, τ- and K-mesons by the spinors $s^\alpha_{\dot{\alpha}}$ and $K_{\dot{\alpha}}$. A possible connection with the Goldhaber-Gyórgyi model of hyperons is discussed.

539.11

5485 RELATIVISTIC EQUATION OF MOTION FOR SPINNING PARTICLES. K.Nagy.
Acta phys. Hungar., Vol. 7, No. 3, 325-39 (1957).

The kinematic energy–momentum tensor of the spinning point particle is determined. The equations of motion for translation and spin are derived from the fact that the tensor is divergence-free. The method is applied to the investigation of the equations of motion for an electrically charged particle with magnetic momentum.

539.11

5486 γ_5-INVARIANCE AND THE VANISHING OF THE OBSERVABLE MASSES. K.L.Nagy.
Acta phys. Hungar., Vol. 10, No. 4, 449-50 (1959).

Suggests an alternative proof, based on perturbation theory, that γ_5-invariance and zero bare mass imply zero real mass.
R.J.N.Phillips

539.11

5487 EXTENSION OF THE FUNCTIONAL THEORY TO PARTICLES OF SPIN $\frac{1}{2}$. F.Aeschlimann.
J. Phys. Radium, Vol. 18, No. 8-9, 523-6 (Aug.-Sept., 1957). In French.

539.11

5488 EXTENSION OF THE FUNCTIONAL THEORY OF PARTICLES TO THE NUCLEON AND PHOTON. F.Aeschlimann.
J. Phys. Radium, Vol. 18, No. 10, 562-6 (Oct., 1957). In French.

539.11

5489 ON THE FERMI ZERO-POINT KINETIC ENERGY OF PARTICLES WITH SPIN $\frac{1}{2}$. P.Szépfalusy.
Acta phys. Hungar., Vol. 7, No. 4, 433-46 (1957).

In the calculation of the Fermi zero-point kinetic energy, the sum of the kinetic energies of the particles is approximated by integration in the phase space. A procedure is developed by which this approximation can be avoided, i.e. by which the summation can be carried out exactly by making certain assumptions, thus yielding a more accurate expression for the zero-point kinetic energy.

539.11

5490 ON A NEW EXCHANGE POTENTIAL. P.Szépfalusy.
Acta phys. Hungar., Vol. 7, No. 3, 357-64 (1957).

In the investigation of systems consisting of particles of spin $\frac{1}{2}$ by the Hartree–Fock method there occurs the operator of exchange interaction. The semi-classical analogue of this operator is known for various interaction potentials. A method is presented which makes possible a more accurate determination of the semi-classical analogue of the exchange operator. The detailed calculations have been carried out for the Coulomb potential.

539.11

5491 SPATIAL AND TIME REFLECTIONS IN RELATIVISTIC THEORY. Yu.M.Shirokov.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 140-50 (Jan., 1960). In Russian.

A complete classification is given for the representations of the inhomogeneous Lorentz group including reflection in space and time reflections of the Wigner type. A detailed study was made of the values of the squares of various reflection operations for particles of halfinteger spin. The general results are compared with the results obtained by imposing additional requirements, particularly the requirement of locality of the field operators. It was found that besides mass, spin and parity, elementary particles possess one more purely geometrical characteristic which may be called symmetry type. The question of the symmetry types of real particles is discussed.

539.11 : 539.16

POLARIZATION OF ELECTRONS AND TIME PARITY. See Abstr. 4050

539.11

5492 A DERIVATION OF THE PAIRING-CORRELATION METHOD. B.F.Bayman.
Nuclear Phys., Vol. 15, No. 1, 33-8 (Feb. [1], 1960).

A discussion is given of the problem of a system of fermions moving in a set of single-particle orbits, and interacting by means of a pairing force. The Bardeen–Cooper–Schrieffer equations are derived by a method which exhibits their approximation as that inherent in the saddle-point method, and without the introduction of fluctuations in the number of particles.

539.11

5493 THIRRING MODEL WITH VARIABLE INTERACTION. F.L.Scarf.
Phys. Rev., Vol. 117, No. 3, 868-72 (Feb. 1, 1960).

The Thirring model (Abstr.2758 of 1958) is solved with a variable coupling constant, $\lambda = \lambda_0 f(x,t)$. It is found that the infrared divergence is eliminated if f tends to zero along the past light cone. The S matrix is no longer diagonal in the physical particle representation and is generally not well-defined in the sense of Haag's theorem. The ordered, renormalized Heisenberg operators for ψ, $\psi\psi^*$ are computed and production processes are analysed by examining matrix elements.

539.11

5494 DISPERSION RELATIONS IN THE LEE MODEL. P.De Celles and G.Feldman.
Nuclear Phys., Vol. 14, No. 3, 517-21 (Jan. [1], 1960).

The self-energy and the wave-function renormalization constant in the Lee Model are calculated with the technique of dispersion relations. The results agree with those obtained in the usual manner.

539.11

5495 A CONTRACTION RULE FOR COMPOSITE PARTICLES. R.Blankenbecler.
Nuclear Phys., Vol. 14, No. 1, 97-105 (Dec. [1], 1959).

A contraction rule for an arbitrary composite particle, (suitable for description of interactions of such a particle), is derived, based on results due to Nishijima (1955), and Klein and Zemach (1957). The relation between this contraction rule and the analogous problem in potential scattering is demonstrated by an explicit reduction to the nonrelativistic limit. Applications of these rules are briefly discussed.

539.11

5496 CAUSALITY COMPLEMENTARITY AND S-MATRIX FORMALISM IN A NON-LOCAL RELATIVISTIC THEORY OF FIELDS. G.Wataghin.
Nuovo Cimento, Vol. 14, No. 5, 1157-65 (Dec. 1, 1959).

A new formalism of a non-local theory is suggested permitting one to substitute the description of point-interactions and point particles by interactions taking place in certain 4-dimensional domains and by an approximate description of propagation of fields representing extended physical particles. The conditions of relativistic invariance and of macroscopic causality result compatible with the above limitations because the interactions can be described by the S-matrix in p-space and studied independently from the propagation problem.

539.11

5497 QUANTIZATION OF THE TWO-COMPONENT FERMION THEORY. M.Tonin.
Nuovo Cimento, Vol. 14, No. 5, 1108-19 (Dec. 1, 1959).

The two-component fermion field, studied by Brown (Abstr. 1068 of 1959), satisfying a second order Pauli wave-equation is quantized. Anticommutation rules for the two-component spinors describing the fermion field are found which are particularly simple. The possibility of extending to this case Wick's theorem is shown, and therefore rules of calculation for the Feynman diagrams are obtained, which are strictly closed to the rules for the quantum electrodynamics of Klein–Gordon particles.

539.11

5498 MINIMUM PROPERTY IN THE HULTHÉN-TYPE VARIATIONAL METHODS. T.Ohmura.
J. math. Phys. (New York), Vol. 1, No. 1, 27-34 (Jan.-Feb., 1960).

The nature of the extremum of the phase shift in the variation principles, which are all based on the Schrödinger differential equation directly, is investigated in detail. If the system has no bound state, the scattering length determined by the original Hulthen method is proved to have the minimum character. The minimum nature is maintained even for the system which has several bound states, if the trial function is taken to be orthogonal to the bound state wave functions. The Kohn method and the second Hulthen method give neither an upper bound nor a lower bound for the phase shift in general. The sufficient condition is, however, obtained for each case, under which the stationary expression for the scattering length has the minimum character. The condition does not hold true for the electron–hydrogen atom scattering for the Kohn

method and for the second Hulthen method. It is pointed out that a comparison of approximate values obtained by different methods using the same trial function does not afford any information about the "proper source of errors" of the results.

539.11

5499 STATIONARY EXPRESSION FOR EFFECTIVE RANGE. T.Ohmura.

J. math. Phys. (New York), Vol. 1, No. 1, 35-40 (Jan.-Feb., 1960).

A variation principle is presented for the effective range of s wave scattering. This principle applies both to the bound state and to the scattering state. It is proved that some of the stationary expressions for the effective range has the minimum value for the exact solution, thus the calculated value by using an approximate wave function gives an upper bound for the effective range. A modified method is also proposed which may simplify the calculation in an actual application. The stationary expression gives, however, neither an upper bound nor a lower bound.

539.11

5500 MANDELSTAM REPRESENTATION FOR POTENTIAL SCATTERING. A.Klein.

J. math. Phys. (New York), Vol. 1, No. 1, 41-7 (Jan.-Feb., 1960).

A proof of the Mandelstam representation for the nonelativistic scattering amplitude is given when the potential is of the Yukawa form or (by obvious extension) a suitable linear combination of such forms. The analytic properties of the scattering amplitude as a function of momentum transfer are established by using only a finite sequence of equivalent definitions of the scattering amplitude. By studying the Born series for individual partial waves, it is shown in addition that there cannot be an essential singularity at infinity. Together, these results imply both dispersion relations for individual partial waves and the Mandelstam representation.

539.11

5501 WIGNER'S INEQUALITIES FOR RELATIVISTIC SCATTERING. P.Menotti.

Nuclear Phys., Vol. 14, No. 2, 232-7 (Dec. [2], 1959).

Wigner's inequalities for the momentum derivatives of the scattering phases are extended to the relativistic scattering of particles of spin zero and one-half by a central potential of finite range.

539.11

5502 HIGH-ENERGY LIMIT OF SCATTERING CROSS SECTIONS. D.Amati, M.Fierz and V.Glaser.

Phys. Rev. Letters, Vol. 4, No. 2, 89-91 (Jan. 15, 1960).

Under the assumption that the total cross-sections for a particle and its antiparticle both tend to finite limits as the energy tends to infinity, it is shown that not only must the limits be equal, but also that the difference $[\sigma^+(E)-\sigma^-(E)]$ must tend to zero faster than $1/\ln E$. It is also shown that

$$\lim_{E\to\infty} [D^+(E) - D^-(E)]/E = 0,$$

where $D^\pm(E)$ are the dispersive parts of the forward scattering amplitudes. R.F.Peierls

539.11

5503 BEHAVIOUR OF THE FERMION SPIN IN ELASTIC SCATTERING. A.A.Sokolov and M.M.Kolesnikova.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 165-71 (Jan., 1960).
In Russian.

Behaviour of the fermion spin in elastic scattering is investigated in its dependence on the type of the interaction. In the ultrarelativistic case (or in the case of the zero rest mass particles) it is shown that the angle between the spin pseudovector and the momentum remains unchanged for the V- and A-interactions while for S, P and T-interactions this angle is changed by 180°.

539.11

5504 ON THE INCLUSION OF HOLE–HOLE SCATTERING IN THE BRUECKNER t-MATRIX.

J.S.R.Chisholm and E.J.Squires.

Nuclear Phys., Vol. 13, No. 1, 156-63 (Oct. (1), 1959).

A discussion is given of the effect of including hole–hole scattering terms in the Brueckner t-matrix method applied to large fermion systems with attractive separable potentials. The nature of the singularity in the t-matrix equation is considerably altered, and, for the infinite system, the new t-matrix can be written as the sum of a non-singular form and a δ-function.

539.11

5505 THE GREEN'S FUNCTION IN THE MODEL OF SCALAR CHARGED MESONS WITH A FIXED SOURCE.

B.M.Barbashov and G.V.Efimov.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 198-200 (Jan., 1960).
In Russian.

A new method of calculating the Green's function, differing from the perturbation theory method, is given, and illustrated for the case of a static nucleon interacting with charged scalar mesons.

539.11

5506 FIXED-SOURCE MESON THEORY. B.Touschek.

Nuovo Cimento Suppl., Vol. 14, No. 2, 242-58 (1959).

The foundations of fixed source meson theory are given, and the Low equation derived. This equation is linearized, by using the optical theorem, and the resulting equation is shown to be a non-relativistic dispersion relation. E.J.Squires

539.11

5507 ON THE BOSON MASS RENORMALIZATION CONSTANTS IN PSEUDOSCALAR MESON THEORY.

J.W.Moffat.

Nuclear Phys., Vol. 13, No. 1, 150-5 (Oct. 1, 1959).

The purpose of this paper is to investigate the significance of Lehmann's theorem, which states that for pseudoscalar mesons $\delta m^2 \leq 0$. This theorem does not allow the meson mass to be ascribed to self-mass effects alone. By including a $\lambda\phi^4$ term in the Lagrangian it is proved that Lehmann's theorem is no longer necessarily fulfilled. On the basis of this conclusion one can no longer exclude the possibility that the mass of the meson in the absence of interaction is zero, and that the ϕ^4 coupling produces most of the observable meson mass. However, in view of the singular behaviour of the modified propagator, the vacuum expectation value $\langle\phi^2\rangle_0$ is divergent and δm^2 appears to be either infinite or indeterminate.

539.11

5508 RELATIVISTIC TWO-BODY PROBLEM IN THE CLASSICAL THEORY OF MESON FIELD.

G.Marx and M.A.Ziegler.

Acta phys Hungar., Vol. 7, No. 1, 125-33 (1957).

Deals with the motion of two particles of equal masses in a scalar meson field. The relativistic equation of motion, in which the retardation is also taken into account, is integrated numerically. At the point where the absolute value of the meson potential equals the value of the rest energy mc^2 of the particle the acceleration of the two particles attracting each other becomes zero and within this short distance changes its sign: the "relativistic repulsion" arises.

539.11

5509 TWO-NUCLEON POTENTIAL FROM PION FIELD THEORY WITH PSEUDOSCALAR COUPLING.

M.Sugawara and S.Okubo.

Phys. Rev., Vol. 117, No. 2, 605-10 (Jan. 15, 1960).

The two-nucleon potential is derived from ps-ps pion field theory, using the Tamm–Dancoff method with the subsequent appropriate renormalization of the two-nucleon amplitude, up to orders $g^2(p/k)^2$ and $g^4(p/k)$, g^2 being the equivalent ps-pv coupling constant and p,k the nucleon (relative) momentum and rest mass, respectively. The mass and charge renormalizations and the pion–pion scattering term are neglected. It is shown that the only quadratic term is $-V_2(r)(p^2/2k^2)$ + H.c., where $V_2(r)$ is the second order static potential. All remaining terms of order $g^2(p/k)^2$ are converted by a canonical transformation to terms of order $g^4(p/k)$ or a linear combination of a static and an L·S potential. In the case of ps–ps coupling, in particular, no velocity-dependent potential besides the quadratic one mentioned above follows from diagrams of one- and two-pion exchange without nucleon pairs; thus the nucleon-pair diagrams are the only source of an L·S potential, if there is any, up to the orders considered. The nucleon-pair diagrams are also estimated assuming the effective pion-pair interaction Hamiltonian, the static limit of which agrees with the S-wave static model of Drell et al. The L·S potential thus obtained has the right sign in the odd state and changes its sign in the even state, while its magnitude seems in both states somewhat too small. As for the static part of this potential, the new correction $[g^4(\mu/k)]$ cancels out the conventional fourth-order term $[g^4]$ appreciably; the entire static potential becomes quite close to the second-order static potential down to distances of the order of the pion Compton wavelength, except for the central force in the triplet even state. The details are shown on graphs. The ps–pv coupling case is treated separately (see following abstract).

539.11

5510 TWO-NUCLEON POTENTIAL FROM PION FIELD THEORY WITH PSEUDOVECTOR COUPLING.
M.Sugawara and S.Okubo.
Phys. Rev., Vol. 117, No. 2, 611-13 (Jan. 15, 1960).

The two-nucleon potential is derived from ps–pv pion field theory theory up to orders $g^2(p/k)^2$ and $g^4(p/k)$ using the method outlined in the preceding abstract. It is shown that the only quadratic term is $-V_2(r)(p^2/2k^2) + \text{H.c.}$ [$V_2(r)$ is the second-order static potential], just as in the ps–ps case. The static part is almost the same as the ps–ps potential. However, a big difference appears in the L·S potential; because of the difference in kinematical corrections from ps–ps and ps–pv vertices, large L·S potentials result from both one-pion and two-pion exchange diagrams (with no nucleon pairs), though no L·S potential follows from such diagrams in case of ps–ps theory. The entire L·S potential has the right sign in the odd state and is of the same sign and of larger magnitude (by a factor of two or three) in the even state. It is shown that this isospin dependence of the L·S potential is not appreciably modified even if one adds, besides the ps–pv coupling term, two pion-pair terms which are fitted to low-energy S-wave pion-nucleon scattering. This big difference in the L·S potential could eventually be used to discriminate between ps–ps and ps–pv theories. Various L·S potentials, theoretical and phenomenological, are shown on graphs for comparison. (See also Abstr. 5621 of 1960).

539.11

5511 PION THEORY OF NUCLEAR FORCES WITH NUCLEON RECOIL. S.N.Gupta.
Phys. Rev., Vol. 117, No. 4, 1146-51 (Feb. 15, 1960).

The nuclear potential between two nucleons with nonrelativistic velocities in their centre-of-mass system is calculated by using the relativistic pion theory and taking fully into account the effect of the nucleon recoil. The resulting potential completely disagrees with the Klein potential (Abstr. 5855 of 1953) but differs from the Lévy potential (Abstr. 621 of 1953) to a lesser extent. It is shown that an expansion of the contribution of the nucleon recoil in powers of the ratio of the pion and nucleon masses leads to erroneous results.

539.11 : 539.14

PARITY MIXTURES IN NUCLEAR STATES. See Abstr. 4030

539.11

5512 SIMPLE NON-LOCALIZABLE SYSTEMS. G.Domokos.
Acta phys. Hungar., Vol. 11, No. 1, 81-6 (1960).

Two simple non-local models are investigated: a free oscillator with non-local potential and an oscillator with non-local kinetic and potential energies. Solutions of the classical equations of motion for a finite time interval are obtained, which do not seem to exhibit physically unreasonable features.

539.11

5513 THE PROBLEM OF THE SUBSIDIARY CONDITION IN THE ADDITIONAL VARIABLES METHOD FOR ARBITRARY CENTRAL INTERACTIONS. Z.Galasiewicz.
Acta phys. Polon., Vol. 17, No. 1, 63-70 (1958).

The method of Bohm and Pines is generalized for the case of arbitrary central forces. It is shown that subsidiary conditions imposed on the system wave function result from the equations of motion. In addition, the equivalence of the generalized method and of the method Zubarev (1953) is shown. From this follows the physical significance of the subsidiary conditions imposed on the system wave function in this method.

539.11

5514 SECOND-ORDER FOUR-COMPONENT WAVE EQUATION IN THE SYMMETRICAL THEORY, WITH PSEUDOSCALAR COUPLING. K.Ladányi.
Acta phys. Hungar., Vol. 10, No. 4, 455-6 (1959).

Shows that the Dirac equation, with symmetric pseudoscalar coupling to mesons, can be put in a second-order four-component form. R.J.N.Phillips

539.11

5515 RELATIVISTIC COULOMB WAVE FUNCTION WITH DEFINITE ASYMPTOTIC MOMENTUM AND POLARIZATION. A.Deloff.
Nuclear Phys., Vol. 13, No. 1, 136-9 (Oct. (1), 1959).

A relativistic Coulomb wave-function with definite asymptotic momentum is given in the form of an operator A acting on a plane wave spinor u.

539.11

5516 APPROXIMATION OF VELOCITY-DEPENDENT POTENTIALS BY SEPARABLE KERNELS.
G.Targonski.
Nuovo Cimento, Vol. 14, No. 5, 1093-101 (Dec. 1, 1959).

The Schrödinger equation for a two-nucleon problem with velocity-dependent forces contains an integral operator; the kernel of this might be approximated by a separable kernel, then the equation can be easily solved. A method to construct the best separable approximation is given; the goodness of which is expressed in a simple way with the eigenvalues. It turns out that a reasonable approximation is possible if the first eigenvalue of the kernel is non-degenerate and widely separated from the next one. The properties of the approximation remain unchanged in momentum space representation.

539.11

5517 TRANSFORMATION BRACKETS FOR HARMONIC OSCILLATOR FUNCTIONS. M.Moshinsky.
Nuclear Phys., Vol. 13, No. 1, 104-16 (Oct. (1), 1959).

The author defines the transformation brackets connecting the wave-functions for two particles in an harmonic oscillator common potential with the wave-functions given in terms of the relative and centre-of-mass coordinates of the two particles. With the help of these brackets it is shown that all matrix elements for the interaction potentials in nuclear shell theory can be given directly in terms of Talmi integrals. The author obtains recurrence relations and explicit algebraic expressions for the transformation brackets that will permit their numerical evaluation.

ELEMENTARY PARTICLES

539.12

5518 MICROSCOPIC TESTS OF SYMMETRY PRINCIPLES. G. Feinberg and M.Goldhaber.
Proc. Nat. Acad. Sci. U.S.A., Vol. 45, No. 8, 1301-12 (Aug., 1959).

It is examined how far the generally accepted conservation laws — of charge, baryon number, and lepton number — are based on direct experimental evidence. P.K.Kabir

539.12

5519 ON THE EXISTENCE OF PARTICLES WITH MASSES OF $2m_e \leq \mu \leq 25m_e$.
A.N.Garbunov, V.M.Spiridonov and P.A.Cherenkov.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 69-73 (Jan., 1960).
In Russian.

Experiments were made with a Wilson cloud chamber in a magnetic field for the purpose of detecting possible generation of particles of mass 2 m_e to 25 m_e in a lead target placed in the 265 MeV bremsstrahlung beam from a synchrotron. It is shown that if particles of mass from 2 m_e to 25 m_e, spin $\frac{1}{2}$ and lifetime over 10^{-9} sec exist, the cross-section of their production in electromagnetic interactions is more than two orders smaller than the value expected.

539.12

5520 e/m BY THE HOAG METHOD. B.L.Miller.
Amer. J. Phys., Vol. 27, No. 2, 120-1 (Feb., 1959).

A mathematical proof is given of the correctness of measuring "l" in the Hoag method from the centre of the deflecting plates. This is shown to be true in the case of symmetrical fringing.
E.G.Knowles

539.12

5521 A COMPARISON OF THE CHARGES OF THE ELECTRON, PROTON AND NEUTRON. A.M.Hillas and T.E.Cranshaw.
Nature (London), Vol. 184, 892-3 (Sept. 19, 1959).

An experiment is described which seeks to establish a difference in the magnitudes of the electric charges on the electron and the proton by attempting to detect a charge on a large volume of de-ionized gas. In view of the experimental difficulties the conclusions remain quite uncertain. S.J.St-Lorant

539.12

5522 A COMPARISON OF CHARGES OF THE ELECTRON, PROTON AND NEUTRON. H.Bondi and R.A.Lyttleton.

Nature (London), Vol. 184, 974 (Sept. 26, 1959).

Discussion of the experiment described in the preceding abstract.

S.J.St-Lorant

539.12

5523 ON THE PARITY OF K–BARYON VERTICES. D.Kleitman.

Nuclear Phys., Vol. 14, No. 1, 33-41 (Dec. [1], 1959).

The baryon mass spectrum is examined for a set of theories in which π-mesonic interactions are universal and K-mesonic interactions distinguish between nucleons and cascade particles only through their having opposite space inversion properties. The nucleon-cascade particle mass splittings for such theories are evaluated through use of the approximations that vertex corrections in the mass operator may be ignored, and that only the leading divergent terms in the mass renormalization need be considered. It is shown that this splitting only has the correct sign if nucleon–K-meson vertices are scalar rather than pseudoscalar.

539.12

5524 DIFFUSION THEORY FOR POLARIZED PARTICLES. L.Waldmann.

Z. Naturforsch., Vol. 15a, No. 1, 19-29 (Jan., 1960).

The multiple elastic scattering of polarized particles is governed by a generalized Boltzmann equation. The properties of the collision brackets connected with this equation—definiteness and invariances—are studied. The state near equilibrium, i.e. nearly isotropic distribution of velocities and spins, is considered (diffusion theory). To describe an ensemble of spin-$\frac{1}{2}$ particles one needs in the most simple non-equilibrium approximation two scalars (one pseudo) and four vectors (two pseudo). The scalars are: density of number and helicity. The vectors are: particle stream, density of velocity-spin vector ($v \times s$), stream of helicity and density of transverse spin. These scalars and vectors are connected by linear differential equations (diffusion relaxation equations). The entropy and the Onsager–Casimir relations are discussed. The theory, supplemented by boundary conditions, is applied on the multiple scattering of spin-$\frac{1}{2}$ particles by a thick foil.

539.12

5525 A GENERAL EQUATION FOR SCATTERING AMPLITUDES OF PARTICLES IN THE FIELD THEORY. W.Królikowski.

Acta phys. Polon., Vol. 16, No. 5, 327-34 (1957).

A formally exact relation is obtained for the elements of the s matrix corresponding to two given numbers of particles. All elements with other numbers of particles are eliminated. Low's general equation derived previously (Abstr. 8410 of 1957) is a special case, when both the distinguished numbers of particles are identical. If the two numbers of particles, say N_1 and N_2, are different, then the equation obtained connects the transition $N_1 \rightarrow N_2$ with the transition $N_1 \rightarrow N_1$, e.g. the photoproduction of pions with the Compton effect on nucleons. If the transition amplitude for the process $N_1 \rightarrow N_1$ is known, then that for the process $N_1 \rightarrow N_2$ satisfies a linear equation.

539.12

5526 WEAK INTERACTIONS OF FERMIONS. J.M.Cassels.

Nuovo Cimento Suppl., Vol. 14, No. 2, 328-39 (1959).

The theory of weak interactions of non-strange particles is discussed in the framework of the universal V-A interaction, with lepton conservation and left handed neutrinos. The available experimental evidence on the three legs of the Puppi triangle is discussed and shown to be in agreement with this theory. E.J.Squires

539.12

5527 PRESENT PROBLEMS IN THE THEORY OF WEAK INTERACTIONS. R.Gatto.

Nuovo Cimento Suppl., Vol. 14, No. 2, 340-68 (1959).

The V-A theory of weak interactions is formulated in terms of the coupling of a current to itself, and the possible forms of this current are discussed. It is shown that the current must contain terms with $\Delta Q = -1$ and with $\Delta S = -1$ and 0. Evidence is presented against $\Delta S = +1$ terms, but it is not possible to exclude $\Delta G = 0$ completely. The suggestion that the weak interaction is mediated by a charged boson is discussed. The properties of the interaction in isotopic spin space are considered, and it is seen that the $\Delta T = \frac{1}{2}$ rule for interactions, which seems to be indicated by experiment, is not easy to fit into this scheme. Finally, the hypothesis of non-renormalization of the currents is discussed. E.J.Squires

539.12

5528 TWO-CENTRE MODEL AND HYDRODYNAMIC THEORY OF MULTIPLE PARTICLE PRODUCTION. A.A.Emel'yanov and I.L.Rozenthal'.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 194-7 (Jan., 1960). In Russian.

It is pointed out that in case of fluctuations of the initial volume or final temperature values the hydrodynamic theory of collisions of high-energy particles may result in kinematics similar (but not identical) to that predicted by the two-centre model.

539.12 : 530.12

LAGRANGE FUNCTION FOR THE MOTION OF CHARGED PARTICLES IN GENERAL RELATIVITY THEORY.
See Abstr. 4936

Photons

539.12

5529 STRUCTURE OF THE GREEN'S FUNCTION OF A PHOTON. D.A.Kirzhnits, V.Ya.Fainberg and E.S.Fradkin.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 239-42 (Jan., 1960). In Russian.

It is shown that the so-called Redmond procedure (Abstr. 2054 of 1959) is not unambiguous. This conclusion does not change when the requirements of renormalization invariance are taken into account.

539.12

5530 ON ELECTROMAGNETIC RADIATION REACTION. A.Peres.

Bull. Res. Coun. Israel, Vol. 7F, No. 4, 171-4 (Dec., 1958).

The radiation field of a system of slowly moving charged particles is expanded into powers of (v/c), and the work performed against it by the particles is computed. The first approximation gives the dipole radiation, and the next one the electric quadrupole and magnetic dipole radiations.

539.12

5531 CONTRIBUTION TO THE THEORY OF COHERENT SPONTANEOUS RADIATION. V.M.Fain.

Zh. eksper. teor. Fiz., Vol. 36, No. 3, 798–802 (1959). In Russian.

Some problems relating to the theory of coherent spontaneous radiation are considered. It is shown that the interaction of the particles via the common radiation field leads to a shift in the proper frequencies of the system.

539.12

5532 THE ENERGY DISTRIBUTION OF γ QUANTA FROM A POINT SOURCE OF γ RADIATION IN AN INFINITE SANDY MEDIUM. V.V.Matveev, A.D.Sokolov and R.S.Shlyapnikov.

J. nuclear Energy, Vol. 4, No. 4, 465-70 (April, 1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 4, 57 (1956).

The γ-ray spectra at various distances from point sources of Cr^{51}, Zn^{65}, Ra, and Tl^{208} situated in an effectively infinite sandy medium have been investigated, using a scintillation spectrometer. The results show that when γ radiation passes through sand, a soft component of energy ~ 50 keV builds up, irrespective of the primary γ-ray energy.

539.12

5533 SCATTERING OF GAMMA QUANTA BY NUCLEONS NEAR THE MESON PRODUCTION THRESHOLD. L.I.Lapidus and Chou Guan-chao [Chou Kuang-chao].

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 201-11 (Jan., 1960). In Russian.

Elastic scattering of γ-rays near the single meson production threshold is examined with the aid of dispersion relations. It is shown that if meson production in the s-state is taken into account, perceptible non-monotonies result in the energy dependence of the scattering amplitudes, cross-sections and other observable quantities near the reaction threshold. The scattering amplitudes, differential and total cross-sections of elastic scattering of non-polarized and polarized γ-quanta on protons, as well as the polarization of recoil protons above the production threshold, were calculated under certain assumptions concerning the analysis of photoproduction in a γ-quantum energy range of up to 220 MeV.

539.12

5534 CROSS-SECTION FOR THE ABSORPTION OF QUANTA THROUGH PAIR-FORMATION. H.Hübel, P.Roh and M.Scheer.

Naturwissenschaften, Vol. 46, No. 20, 574-5 (1959). In German.

The cross-section of copper, silver and lead for pair formation is determined experimentally. The results confirm that the cross-section determined theoretically by means of Born's first approximation requires to be corrected by a term proportional to the square of the atomic number. The suggestion of certain authors that the correction term may be a more complicated function of atomic number is therefore rejected. A.E.I.Research Laboratory

539.12

5535 GAMMA RAY SHIELDING. ABSORPTION OF MONOENERGETIC X- AND γ-RAYS. M.H.Green.

Nucleonics, Vol. 17, No. 10, 77 (Oct., 1959).

Nucleonics Data Sheet No. 34. A nomogram relating the initial and final intensities and the half-value thickness to the linear absorption coefficient. R.D.Smith

539.12

5536 A SIMPLE DERIVATION FOR THE PREMATURENESS (VOREILUNG) OF THE INTENSITY MAXIMUM OF X-RAY BREMSSTRAHLUNG. H.Kulenkampff.

Z. Phys., Vol. 157, No. 3, 282-5 (1959). In German.

The peculiar asymmetry of the angular distribution of bremsstrahlung can be explained in purely mathematical terms but this offers no physical insight. A qualitative method is used analogous to the derivation of the motion of a missile projected from a moving gun to obtain the exact formula. It was concluded that the observed asymmetry has nothing to do with the Doppler effect. T.Mulvey

539.12

5537 RADIATION FROM HIGH-SPEED PARTICLES. P.A.Cherenkov.

Science, Vol. 131, 136-42 (Jan. 15, 1960).

Based on Nobel Prize lecture 1958.

539.12

5538 GENERAL CHARACTERISTICS OF VAVILOV–CHERENKOV RADIATION. I.E.Tamm.

Science, Vol. 131, 206-10 (Jan. 22, 1960).

Base on Nobel Prize lecture 1958.

539.12

5539 THE POLARIZATION OF THE CHERENKOV RADIATION OF BETA RAYS IN PLEXIGLAS. F.Smend.

Naturwissenschaften, Vol. 46, No. 24, 665-6 (1959). In German.

Describes the measurement of the nature of polarization of Cherenkov radiation in Plexiglas due to 1.7 MeV electrons from the decay of the P^{32} isotope. S.J.St-Lorant

539.12 : 537.56

ELECTROMAGNETIC RADIATION FROM ELECTRONS ROTATING IN AN IONIZED MEDIUM UNDER THE ACTION OF A UNIFORM MAGNETIC FIELD. See Abstr. 5316

X-rays

539.12

5540 HARD X-RAYS ACCOMPANYING A GAS DISCHARGE. S.Yu.Lukyanov and I.M.Podgorny.

J nuclear Energy, Vol. 4, No. 2, 224-34 (Feb., 1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 3, 79 (1956).

It is shown that hard X-rays are emitted from a high-current gas discharge at low pressure The radiation has been observed with various gases. Fundamental properties of the radiation have been investigated and a possible mechanism for its production is considered.

539.12

5541 CINEFLUOROGRAPHY EMPLOYING SPLIT-IMAGE TELEVISION TYPE IMAGE AMPLIFIERS. P.C.Hodges and R.D.Moseley, Jr.

Radiology, Vol. 73, No. 4, 548-56 (Oct., 1959).

A cathode-ray tube directly sensitive to X-rays is described and compared with the existing systems of X-ray image amplification devised by Morgan, Westinghouse, Philips and Moon. The X-ray image falls on an Al anode plate surfaced with a layer of lead oxide which becomes semiconducting corresponding to the image. The cathode beam scans the anode and the change in anode current can be amplified and transferred to monitor screens by conventional television electronics. Storage properties of the screen are good; the resolving power of the system depends on the size of the cathode-ray scanning beam. X-ray sets mounted at right angles and feeding two such cameras have been used in angiography, together with a remote monitor for motion picture recording. D.V.Mabbs

Electrons

539.12 : 539.18

5542 DIRAC CONTINUUM RADIAL WAVE FUNCTIONS. H.S.Perlman and B.A.Robson.

Austral. J. Phys., Vol. 12, No. 1, 30-41 (March, 1959).

Tables of Dirac continuum radial wave-functions for an electron in the Coulomb field of a mercury nucleus (Z = 80) are presented for several energies and l's. Approximate methods of interpolation and extrapolation to regions not covered explicitly are indicated.

539.12 : 539.2

5543 ENERGY LEVELS OF AN ELECTRON IN THE FIELD OF A FINITE DIPOLE. R.F.Wallis, R.Herman and H.W.Milnes.

J. molecular Spectrosc., Vol. 4, No. 1, 51-74 (Jan., 1960).

A quantum mechanical investigation has been made of the energy levels of an electron moving in the field of two fixed charges with values +e and -e and having a separation R. The Schrödinger equation for this problem is separable in confocal elliptic coordinates. The evaluation of the energy eigenvalues requires the solution of two simultaneous transcendental equations involving continued fractions. The solutions of these transcendental equations have been worked out for the ten lowest bound states over a range of values of R. The binding energy of the electron decreases monotonically as R decreases for all states considered. For a given state the electronic binding energy is very small for values of R less than the Bohr radius of the corresponding hydrogenic state obtained by letting $R \to \infty$. Applications of the results to colour centre problems and to other solid state physics problems are discussed.

539.12

5544 INTERACTION BETWEEN ELECTRONS AND COHERENT [ELECTROMAGNETIC] FIELDS. B.Fogarassy.

Acta phys. Hungar., Vol. 10, No. 3, 305-25 (1959).

The expectation value and mean square deviation of electron velocity are determined more generally than has been done previously. The calculations are performed by quantum mechanical, as well as classical, methods, and it is shown that the two methods do not lead to different results. Consequently, it can be said that the behaviour of a coherent field with respect to free electrons is the same as that of a classical field, apart from the zero point fluctuation.

539.12

5545 ASYMPTOTIC BEHAVIOUR OF HIGHER FACTORIAL MOMENTS OF ELECTRON–PHOTON CASCADES AT LARGE DEPTHS. J.Czerwonko.

Acta phys. Polon., Vol. 16, No. 5, 305-26 (1957).

Investigated in approximation "A". The differential cross-sections satisfying the conditions of homogeneity are positive, and, in addition, are arbitrary functions. It is assumed that the Bremsstrahlung cross-section is greater than the pair formation cross-section. The main results are: (1) The main factor determining the development of the cascades at large depths is the product of the total number of particles and the threshold energy. Systems with a smaller value of this variable are privileged. (2) Photons, as primary particles, are "stronger" than electrons — a generalization of the conclusions of Stachowiak (Abstr. 5044 of 1957) for moments of any order. (3) Privileged configurations of electrons and photons were obtained. It turns out that configurations containing an even number of electrons different from zero are privileged. The weakest configuration for N particles is N photons and zero electrons when $N > 1$.

539.12

5546 SCATTERING OF ELECTRON FROM FIVE DIMENSIONAL WAVE EQUATION. A.K.Mitra.

Indian J. Phys., Vol. 32, No. 7, 336-9 (July, 1958).

The solution of the radial part of the five dimensional wave equation for the case of scattering of an electron in a Coulomb field has been considered and it is found that half integral quantum

numbers appear in the solution which lends support to the idea that the influence of the fifth coordinate is somewhat analogous to the existence of the spin.

539.12

5547 RANGE OF 1-10 keV ELECTRONS IN SOLIDS. C.Feldman.
Phys. Rev., Vol. 117, No. 2, 455-9 (Jan. 15, 1960).

The range of 1-10 keV electrons in metals and phosphors was measured by recording the light output as a function of energy from a sample consisting of a metallic layer deposited on a transparent phosphor layer. The measurements lead to the development of the following range-energy expression:

$$R = 250(A/\rho Z^{n/3})E^{n},$$

where

$$n = 1.2/(1 - 0.29 \log_{10} Z),$$

E = energy in keV, R = range in angstroms, and A, ρ, Z, have their customary meaning. This differs from the usual range expression in the dependency of n on Z. Usually n is assumed to be independent of material. This dependency can be justified on the basis of Bethe's theory of electron stopping power.

539.12

5548 FIRST FORBIDDEN BETA TRANSITIONS FOR THE UNIVERSAL FERMI INTERACTION. B.Kuchowicz.
Acta phys. Polon., Vol. 18, No. 4, 347-60 (1960).

Formulae are presented for the electron polarization in recoil experiments for the case of first forbidden beta transitions. The formulae are derived by means of the Cutkosky–Deloff trace technique. All Coulomb effects (for a point nucleus) are included. In accordance with the present knowledge of β-decay, the vector and axial vector parts of the universal Fermi interaction are retained, with different coupling constants. The formulae for the case of $0 \rightarrow 0$ (yes) transitions are compared with the formulae given by Berestetsky et al (Abstr. 6255 of 1958; 1741 of 1959). Some discrepancies are shown to exist in the asymptotic form. An attempt has been made to explain this.

539.12 : 539.2

5549 ON POSITRON LIFETIME IN ANTHRACENE. C.Cottini, G.Fabri, E.Gatti and E.Germagnoli.
Nuovo Cimento, Vol. 14, No. 2, 454-5 (Oct. 16, 1959).

The temperature dependence of the lifetime of positrons in anthracene was measured over the range –200° to 295°C by sandwiching a thin source of $Na^{22}Cl$ between two anthracene crystals and measuring the delay spectrum of the annihilation quanta with respect to the 1.28 MeV γ-rays. The decay time of the positrons up to a temperature a few degrees below the melting point (217°C) was fairly constant and had the value $(3.7 \pm 0.2) \times 10^{-10}$ sec. Above this, a rapidly increasing proportion of the positrons decayed with a longer lifetime and the measured lifetime reached a constant value of 2.3×10^{-9} sec a few degrees above the melting point Comparison between single crystals and polycrystalline samples of anthracene showed no significant difference except for a possible slight increase at low temperatures in the latter case. The results are similar to those obtained for naphthalene. R.E.Meads

539.12

5550 THE EFFECT OF POLARIZATION ON THE ELASTIC SCATTERING OF POSITRONS BY HYDROGEN ATOMS. A.H.Mousa.
Proc. Phys. Soc., Vol. 74, Pt. 1, 101-4 (July 1, 1959).

The Hulthén and Kohn variational methods are applied to a further consideration of the effect of polarization in the scattering of slow positrons by hydrogen atoms. A trial function is used which allows for virtual positronium formation. Although the results indicate a greater effect of polarization than those of previous calculations using a mathematically simpler but physically less appropriate trial function, the effect is much less than seems to be required from the experimental results on the scattering of slow positrons by rare gas atoms.

539.12

5551 THE PAIR PRODUCTION CROSS SECTION FOR HIGH PHOTON ENERGIES FOR THE THOMAS–FERMI AND HARTREE ATOM. T.Tietz.
Acta phys. Hungar., Vol. 11, No. 1, 47-51 (1960).

Using analytical representations of the Thomas–Fermi junction $\varphi(x)$ and the Hartree functions Zp/Z, the total cross-section formula is derived for pair production in the field of an atom of atomic number Z. The calculated values for the total cross-section agree well with the exact numerical values of Bethe (1934) and Fraser (Abstr. 8438 of 1952).

539.12 : 539.18

POSITRON LOW-ENERGY SCATTERING ON ATOMIC HYDROGEN. See Abstr. 4167

539.12 : 539.2

POSITRON ANNIHILATION IN METALS. POINT SINGULARITY SCREENING. See Abstr. 4296

Nucleons

539.12

5552 NUCLEON STRUCTURE. M.Cini.
Nuovo Cimento Suppl., Vol. 14, No. 2, 408-14 (1959).

It is shown how the interaction of electrons with nucleons can be described in terms of charge and magnetic moment form factors, and how the r.m.s. radii of these quantities can be obtained from electron scattering data. Dispersion relations for the form factors are quoted, and approximate calculations outlined. The discrepancy in the calculated isotopic vector part of the charge distribution suggests that there must be a pion–pion interaction. E.J.Squires

539.12

5553 RATIO OF NUCLEON MASS AND ELECTRON MASS. A.J.Rutgers.
Nature (London), Vol. 184, 894 (Sept. 19, 1959).

Assuming that the nucleon mass is given by $M_N = g^2/2r_0c^2$ where $g^2/\hbar c$ is the value of the pion–nucleon interaction constant, the ratio of the masses of the nucleon and the electron is $M_N/M_e = 1920$. S.J.St-Lorant

539.12

5554 EFFECT OF STRANGE PARTICLES ON NUCLEON MAGNETIC MOMENT. S.K.Kundu.
Proc. Phys. Soc., Vol. 75, Pt 2, 217-19 (Feb., 1960).

The contribution from hyperons and K-mesons to nucleon magnetic moment is calculated in the non-relativistic limit to the second order in the coupling constant. The Hamiltonian chosen corresponds to the derivative coupling of the pseudo-scalar K-meson with a fixed extended source. To fit with the existing experimental results for neutron magnetic moment a lower limit to the N–π coupling is suggested. Also the N–K–$\frac{1}{2}$ coupling is found here to be much smaller than the N–π coupling.

539.12

5555 ANOMALOUS MAGNETIC MOMENTS OF PROTON AND NEUTRON. S.K.Kundu.
Indian J. Phys., Vol. 31, 526-30 (Oct., 1957).

The proton and the neutron magnetic moments have been calculated with a classical model consisting of spatially extended core charge and a meson cloud charge, both having spherical symmetry.

539.12

5556 PERIPHERAL NUCLEON INTERACTIONS AT ENERGIES OF 9 BeV. I.M.Dremin and D.S.Chernavskii.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 229-32 (Jan., 1960).
In Russian.

Considers the peripheral interaction of two nucleons (9 BeV energy) involving the exchange of one pion. The cross-section of such processes is estimated. It is found that during such peripheral interactions excited nucleons are in a state with an isospin of $\frac{3}{2}$.

Protons

539.12

5557 RANGE-ENERGY RELATION FOR PROTONS IN VARIOUS SUBSTANCES. Y.Pal Varshni.
Indian J. Phys., Vol. 32, No. 8, 373-86 (Aug., 1958).

A simple relation between the range (R) and energy (E) of heavy charged particles is proposed: $R = a(E + c)^n$, where a, c and n are constants. The relation is shown to be quite successful for proton ranges in a number of substances, up to 100 MeV.

539.12

5558 **ON THE P–P SCATTERING AT HIGH ENERGIES.** A.Das.
Indian J. Phys., Vol. 31, No. 10, 511-25 (Oct., 1957).

The nature of p–p scattering is studied with a phenomenological potential of the form $(\tau^{(1)}.\tau^{(2)})(\sigma^{(1)}.\nabla)(\sigma^{(2)}.\nabla)e^{-\chi r}/r^2$.

539.12

5559 **A MEASUREMENT OF THE SPIN CORRELATION COEFFICIENT C_{KP} IN p–p SCATTERING AT 382 MeV. FOR 90° CENTRE-OF-MASS SCATTERING ANGLE.** A.Ashmore, A.N.Diddens and G.B.Huxtable.
Proc. Phys. Soc., Vol. 73, Pt 6, 957-9 (June, 1959).

The measured asymmetry of + 0.178 ± 0.027 was corrected to + 0.235 ± 0.03 to allow for the asymmetry arising from the finite geometry. Polarization analysing powers were measured to be 0.618 ± 0.029 and 0.604 ± 0.026, thus giving C_{KP} = + 0.63 ± 0.10. This result clearly eliminates set 6 of the phase shifts at 310 MeV derived by Stapp, Ypsilantis and Metropolis (Abstr. 3372 of 1957). A.Ashmore

539.12

5560 **RANGE STRAGGLING OF CHARGED PARTICLES IN Be, C, Al, Cu, Pb, AND AIR.** R.M.Sternheimer.
Phys. Rev., Vol. 117, No. 2, 485-8 (Jan. 15, 1960).

For experimental data using protons, see Abstr. 12556 of 1959. The straggling of the range of charged particles due to fluctuations of the ionization loss is evaluated for these six substances. The calculations extend up to $T/\mu c^2 \sim 100$, where T is the kinetic energy and μ is the mass of the incident particle. At high energies ($T/\mu c^2 > \sim 5$), the integral giving the range straggling becomes somewhat dependent on the ratio μ/m, where m is the electron mass. Two separate calculations have therefore been carried out, which apply to protons and μ-mesons, respectively. The results for protons can also be used for π and K-mesons in the energy range of interest ($T/\mu c^2 < \sim 5$).

539.12

5561 **STUDY OF ANTIPROTONS WITH EMULSION TECHNIQUE.** E.Amaldi, G.Baroni, G.Bellettini, C.Castagnoli, M.Ferro-Luzzi and A.Manfredini.
Nuovo Cimento, Vol. 14, No. 5, 977-1026 (Dec. 1, 1959).

Reports the results obtained from the study of 653 antiprotons observed in nuclear emulsions. The cross-sections, averaged over all the nuclei present in emulsion (G-5) as well as over the $\bar{p}$ energy interval from 10 to 230 MeV ($\bar{T}_{\bar{p}}$ = 150 MeV), are given for the following processes: inelastic scattering, elastic scattering and annihilation + charge exchange. The statistics are good enough to give the cross-section for annihilation + charge exchange as a function of the kinetic energy of the incident $\bar{p}$. The annihilation process has been studied in detail for antiprotons annihilating in flight as well as at rest. Among other results the following were obtained: the multiplicity and the spectrum of the $\pi^{\pm}$, the number of pions interacting, on the average, inside the emulsion nucleus where the annihilation takes place, the frequency of emission of the $K\bar{K}$ pairs and the energy balance of the various components emitted by the average emulsion nucleus where the annihilation takes place. From these data the total multiplicity of $\pi^{\pm 0}$ for the annihilation of a $\bar{p}$ with an isolated nucleon is deduced, under the assumption of charge-independence. Finally an estimate is given of the ratio Σ_n/Σ_p, where Σ_n and Σ_p are the probabilities for a $\bar{p}$ at rest to annihilate with the neutrons and protons bound in the emulsion nuclei.

539.12

5562 **INTERACTIONS OF ANTIPROTONS IN NUCLEAR EMULSION.** J.Dyer, H.H.Heckmann, F.M.Smith, Y.Eisenberg, W.Koch, M.Nikoloc, M.Schneeberger and H.Winzeler.
Helv. phys. Acta, Vol. 32, No. 6-7, 559-66 (1959).

The principal experimental results obtained in the present experiment are the following. The annihilation mean free path was found to be $17.1^{+2.0}_{-1.4}$ cm for the energy interval between 40 and 200 MeV. The average number of emitted charged pions per star was 1.80 ± 0.35 for the stars in flight and 2.13 ± 0.38 for the stars at rest. Among the 30 analysed annihilation stars 1 probable K-meson was found. The angular distribution of the elastic scatterings down to a scattering angle of 1° is obtained.

Neutrons

539.12

5563 **SCATTERING AND POLARIZATION EFFECTS OF 3.27 MeV NEUTRONS ON DEUTERONS.** M.Brüllmann, H.J.Gerber, D.Meier and P.Scherrer.
Helv. phys. Acta, Vol. 32, No. 6-7, 511-48 (1959). In German.

The differential cross-section and the azimuthal asymmetry have been measured for 6 angles between 53° and 161° in the centre-of-mass system, using a beam of D–D neutrons with an energy of 3.27 MeV in the laboratory system and a polarization P_0 of 11%. The results are given in terms of polarization $P(\theta)$ of an unpolarized neutron beam after scattering by deuterons. Only negligible values of this polarization $P(\theta)$ have been observed. The experiment is described in detail. The scatterer itself acts as a scintillation counter consisting of deuterated benzene (C_6D_6) and detects the recoil deuterons. A plastic scintillator is used for detection of the neutrons. Coincidences and time distribution of the pulses of the two counters are observed, using a millimicrosecond time-to-pulse-height converter.

539.12

5564 **POLARIZATION OF 2 TO 4 MeV NEUTRONS SCATTERED BY DEUTERONS.** W.P.Bucher, W.B.Beverly, G.C.Cobb and F.L.Hereford.
Nuclear Phys., Vol. 13, No. 1, 164-6 (Oct. [1], 1959).

The polarization of 2 to 4 MeV neutrons scattered by deuterons has been measured by observation of the right–left asymmetry induced in the scattering of polarized neutrons. Results at several energies and scattering angles yield negligibly small values (less than 7%) in agreement with theoretical estimates.

539.12

5565 **POLARISATION OF A DIRAC PARTICLE AND PROTON–NEUTRON SCATTERING.** S.P.Misra.
Indian J. Phys., Vol. 32, No. 8, 355-64 (Aug., 1958).

The polarization problem for nucleon–nucleon scattering in the pseudoscalar meson theory is considered. A direct method has been used. It has been observed by taking the usual S-matrix in the second and fourth orders that polarization in case of such scattering, when initially the particles are unpolarized, is zero, which is in contradiction to the experimental results.

539.12

5566 **ON THE PROBLEM OF NEUTRON DIFFUSION.** N.G.van Kampen.
Proc. K. Ned. Akad. Wetensch. B, Vol. 63, No. 1, 92-107 (1960).

The transfer of radiation through an atmosphere and the diffusion of neutrons through a medium are governed by the same transport equation. In the latter case if the medium is a slab of homogeneous material, and if the individual scattering processes are isotropic, then the general equation reduces in the stationary case to an integro-differential equation in two variables: the distance through the slab and the cosine of the angle between the velocity of the particle and an axis perpendicular to the slab surface. A general expression for the solution of this equation is obtained in the form of definite integrals involving two arbitrary functions. These arbitrary functions are determined by the boundary conditions; in the paper they are determined for the case of a semi-infinite medium. It is pointed out that the results are not new but that the method is more elegant than those previously used. It can be extended to certain types of anisotropic scattering. A.J.Salmon

539.12

5567 **NOTE ON THE SOLUTION OF THE NEUTRON DIFFUSION PROBLEM BY AN IMPLICIT NUMERICAL METHOD.** G.A.Baker, Jr.
Quart. appl. Math., Vol. 17, No. 3, 314-16 (Oct., 1959).

The numerical method of Baker and Oliphant for the solution of time dependent heat flow problems in rectangular regions is extended to obtain the solution of the time dependent neutron diffusion equation in two dimensions. About 5 to 10 iterations are required to ensure convergence. From experience gained using the method, with calculations involving about 2000 mesh points, guidance is given on practical details of the application of the method. A.J.Salmon

539.12

5568 **INVARIANT IMBEDDING AND NEUTRON TRANSPORT IN A ROD OF CHANGING LENGTH.** R.Bellman, R.Kalaba and G.M.Wing.
Proc. Nat. Acad. Sci. U.S.A., Vol. 46, No. 1, 128-30 (Jan., 1960).

In previous papers the authors have used the method of invariant

imbedding to study neutron behaviour in fixed media [Journal of Mathematics and Mechanics, Vol. 8, 575-84 (1959)]. In this paper the medium is a one dimensional rod whose length changes with time. The equations specifying the number of neutrons emerging from one end of the rod, as a function of time are obtained for a process initiated by a 'trigger' neutron entering at the other end.

A.J.Salmon

539.12

5569 SLOWING DOWN AGE OF NEUTRONS FROM A Ra-α-Be SOURCE TO INDIUM RESONANCE IN ALUMINIUM LIGHT WATER MIXTURES. V.P.Duggal and S.M.Puri. Proc. Indian Acad. Sci. A, Vol. 46, No. 1, 72-9 (July, 1957).

An experiment was performed to determine the Fermi age τ up to indium resonance for water and four aluminium-water mixtures, of various volume ratios. The aluminium tank used was fitted with aluminium plates, whose separation could be varied. The neutron distribution was measured by observing the saturation β-activity of indium foils. Theoretical values for τ were computed from Marshak's equation, modified to allow for anisotropic elastic scattering (by the aluminium and oxygen) and inelastic scattering by the aluminium. These values were in agreement with experimental ones. Similar calculations for a fission source were not in good agreement with earlier experimental values, possibly because no allowance was made for absorption of higher energy neutrons by oxygen.

D.H.Lord

539.12

5570 ABSOLUTE CALIBRATION OF A Ra–Be NEUTRON SOURCE. G.P.Felcher, E.Germagnoli and M.Musci. Energia nucleare, Vol. 7, No. 1, 31-8 (Jan., 1960).

The strength of a Ra-Be neutron source (504.81 mg Ra + 2.5g Be) has been determined by absolute measurement of the thermal neutron flux at one position within a water tank and subsequently normalizing the relative values of the neutron flux at any other position. The resulting source strength was $(5.87 \pm 0.18)\ 10^6$ neutrons sec^{-1}.

539.12 : 539.1.07

5571 THE ANALYSIS OF NEUTRON SPECTROMETER RESONANCE DATA. J.E.Lynn and E.R.Rae. J. nuclear Energy, Vol. 4, No. 4, 418-44 (April, 1957).

Methods of analysis of the data obtained with slow-neutron spectrometers are described. The data are obtained from transmission, scattering, capture, and fission measurements. It is shown how relationships between the resonance parameters are obtained, and how these relationships are combined to give values of the individual parameters. Detailed mathematical treatment, where necessary, is given in a series of appendices.

539.12

5572 A PLANE CRYSTAL NEUTRON SPECTROMETER. Yu.Ya. Konakhovich and I.S.Panasyuk. Pribory i Tekh. Eksper., 1959, No. 3, 26-31 (May-June). In Russian.

The spectrometer is being used in a vertical neutron beam from a reactor. The crystals employed are $CaCO_3$, LiF and SiO_2. A beam of monochromatic neutrons having an intensity of 5.3×10^5 neutrons $cm^{-2}\ min^{-1}$ can be obtained at 0.1 eV, the counts to background ratio being 130. The spectrometer is operated by remote control.

S.Chomet

539.12

5573 GLASS SCINTILLATORS FOR NEUTRON DETECTION. L.M.Bollinger, G.E.Thomas and R.G.Ginther. Rev. sci. Instrum., Vol. 30, No. 12, 1135-6 (Dec., 1959).

A preliminary report is given of the characteristics of some clear boron-containing glass scintillators for neutron detection. Experimental data for two types of boron-containing glass activated with cerium is described. The spectrum of pulses resulting from bombardment with thermal neutrons is well separated from the photomultiplier noise pulses. This characteristic, together with their high efficiencies and fast response times, make this type of scintillator attractive for slow-neutron spectroscopy as well as detection.

C.F.Barnaby

Mesons

539.12

5574 NEW EVIDENCE FOR A PARTICLE OF MASS ~ 525 me. N.Basu and M.S.Sinha. Indian J. Phys., Vol. 32, No. 6, 259-66 (June, 1958).

While photographing stopped muons in a multiplate cloud chamber at Calcutta (see level 12°N) nine pictures were obtained in which the rate of change of ionization of the particles and their residual ranges were not compatible with that shown either by μ mesons or by protons. Their mass values were obtained by measuring their change in ionization in the successive gaps and their decrease in residual ranges. Ionization was measured by drop counting. It was found that five of these particles gave an average mass value $528 \pm 34\ m_e$ and the remaining four an average of $280 \pm 21\ m_e$. The close proximity of the latter value with the pion mass is a strong indication for the correctness of the method employed. A probable decay event of the particle of mass ~ 528 m_e has also been given.

539.12

5575 NEUTRAL MESON PRODUCTION BY 930 MeV PROTONS. A.M.Segar and R.Rubinstein. Nuclear Phys., Vol. 14, No. 2, 222-31 (Dec. [2], 1959).

The production of neutral mesons in p–C and p–Al collisions was studied using total absorption Cherenkov counters. The counters were tested in gamma-ray beams arising from π^0-production in internal targets in the synchrotron. Total cross-sections for π^0-production from carbon at 930 and 660 MeV were 69 ± 14 and 21 ± 9 mb. The angular distribution of gamma-rays, in the nucleon–nucleon centre of mass, at 930 MeV, was $1 - (0.2 \pm 0.3)\cos\theta + (0.9 \pm 0.3)\cos^2\theta$. From this the angular distribution of mesons in proton–nucleon collisions is deduced as being $1 + (2.6 \pm 1.6)\cos^2\theta$.

539.12

5576 RADIATIVE MUON DECAY. S.G.Eckstein and R.H.Pratt. Ann. Phys., (New York), Vol. 8, No. 2, 297-309 (Oct., 1959).

Theoretical predictions for the radiative muon decay process $\mu \rightarrow e + \nu + \bar{\nu} + \gamma$ are given in some detail. The differential transition probability for polarized muons is obtained, and from it are calculated the angular correlations of electron and photon, the photon energy spectrum, and the branching ratio. The probability for internal conversion of the photon is estimated. The consequences of an intermediate vector boson are discussed.

539.12

5577 STRUCTURE OF WEAK INTERACTIONS AND UNWANTED PROCESSES. N.Cabibbo and R.Gatto. Phys. Rev., Vol. 116, No. 5, 1334-8 (Dec. 1, 1959).

A general discussion of the forbidden reactions such as $\mu \rightarrow e + \gamma$, $\mu \rightarrow e + e + e$, $\mu + N \rightarrow e + N$, $\mu \rightarrow e + \gamma + \gamma$, etc., which would arise from a possible nonlocal structure of the weak interactions, is given. It is shown, by a canonical transformation, that the dominating terms of the structure, in an expansion in terms of the inverse of the average intermediate mass, do not contribute to any forbidden reaction. A discussion of the μ–e conversion process for a bound μ is given, and the rate is calculated for a particular model.

539.12

5578 SEARCH FOR THE PROCESS $\mu^+ \rightarrow e^+ + \gamma$. T.W.O'Keefe, M.Rigby and J.R.Worhald. Proc. Phys. Soc., Vol. 73, Pt 6, 951-3 (June, 1959).

Counters were arranged to detect in coincidence the positron and γ-ray photon emitted in opposite directions from a muon decaying at rest. A 5 in. NaI crystal was used to measure the positron spectrum. From 4.7×10^5 stopped pions, 42 events were obtained giving a positron spectrum suggestive of continuous background. Only 9 of these events were within the resolving curve of the NaI crystal for 53 MeV positrons, giving an upper limit of the branching ratio, at 99% confidence level, of 7.5×10^{-5}. Further measurements have reduced this to 5.8×10^{-6}.

A.Ashmore

539.12

5579 ON THE STATISTICS OF THE DETERMINATION OF THE MEAN LIFE OF μ-MESONS. L.Jánossy and D.Kiss. Acta phys. Hungar., Vol. 7, No. 1, 107-10 (1957).

The determination of the decay constant by the maximum likelihood method is developed and applied to published data.

539.12

5580 DEPOLARIZATION OF μ-MESONS ON AUGER-CAPTURE IN HYDROGEN. J.Von Behr and H.Marschall. Nuclear Phys., Vol. 14, No. 2, 342-8 (Dec.(2), 1959). In German.

Depolarization of polarized muons by Auger-capture in hydrogen

atoms was estimated. Assuming that the velocity of the muons is distributed randomly with respect to the centre of capture, the degree of polarization of the captured muons is found to be approximately $\frac{1}{3}$.

539.12

5581 RADIATIVE CORRECTION TO PION DECAY. P.Prakash.

An. Acad. Brasil. Cienc., Vol. 31, No. 2, 171-9 (1959).

The distribution in angle and energy of the photon in radiative pion decay is calculated taking the Fermi interaction of V-A form and treating the strong interaction in lowest-order perturbation theory. Second-order radiative corrections are also studied.

P.K.Kabir

539.12

5582 CONNECTION BETWEEN NEUTRAL PION DECAY AND PROTON COMPTON SCATTERING. M.Jacob and J.Mathews.

Phys. Rev., Vol. 117, No. 3, 854-8 (Feb. 1, 1960).

The inclusion of the single-pion intermediate state significantly improves the agreement between theory and experiment for proton Compton scattering. Excitation functions and angular distributions for various assumed values of the π^0 lifetime are presented. On the basis one may definitely exclude π^0 lifetimes $>10^{-16}$ sec or $<5\times10^{-19}$ sec.

539.12

5583 NEUTRAL PIONS. J.M.Cassels, D.P.Jones, P.G.Murphy and P.L.O'Neill.

Proc. Phys. Soc., Vol. 74, Pt 1, 92-6 (July 1, 1959).

The angular correlation between the γ-rays produced in Panofsky reactions:

$$\pi^- + p \rightarrow \pi_0^0 + n \rightarrow 2\gamma + n(+Q_0),$$
$$\pi^- + p \rightarrow \pi_1^0 + n \rightarrow 2\gamma + n(+Q_1).$$

has been measured. The results exclude one of the two possible ways of introducing the π_0^0 proposed by Baldin and Kabir (Abstr. 541 of 1959). On the conventional assumption that there is only one π^0, it is found that $m_{\pi^-} - m_{\pi^0} = (8.90 \pm 0.14)m_e$; the lifetime of the π^0 must be greater than 3×10^{-23} sec.

539.12

5584 THE SPIN OF THE NEUTRAL PION. J.D.Prentice, E.H.Bellamy and W.S.C.Williams.

Proc. Phys. Soc., Vol. 74, Pt 1, 124-30 (July 1, 1959).

An attempt has been made to detect effects due to non-zero π-meson spin. The distribution of photons from the decay of neutral π-mesons was measured and from the results it is concluded either that the spin is zero or that the π-mesons observed were not appreciably polarized.

539.12

5585 RESEARCH ON HIGH ENERGY NEGATIVE π-MESONS IN NUCLEAR EMULSION. D.J.Holthuizen and B.Jongejans.

Nuovo Cimento Suppl., Vol. 14, No. 2, 429-35 (1959).

The possible information which can be obtained from emulsions exposed to a π^- beam of about 5.7 GeV is considered, and some preliminary results are given. A study of the kinematics shows that Λ, Σ and Ξ hyperons will be produced, and the possibility of detecting these is discussed. Results are given for the total pion cross-section in the emulsion. E.J.Squires

539.12

5586 PION–ELECTRON SCATTERING CROSS SECTION AT 1.12 BeV/c. F.S.Crawford, Jr.

Phys. Rev., Vol. 117, No. 4, 1119-25 (Feb. 15, 1960).

The absolute differential cross-section $d\sigma/dK$ negative pions incident on a 10 in. liquid hydrogen bubble chamber, for values of the δ-ray kinetic energy K between 32 MeV and the kinematical upper limit of 62 MeV. The results are in agreement with the theoretical prediction of Bhabha (Abstr. 643 of 1938). An integrated cross-section $\sigma(K > 32\ \text{MeV}) = 1.37 \pm 0.17$ mb was found; this exceeds the theoretical prediction of 1.17 mb by a factor 1.17 ± 0.15. The monoenergetic electron contamination of the pion beam was determined by counting electron-induced δ rays. The monoenergetic and non-monoenergetic contributions to the muon contamination have both been determined by combining a determination of the number of muon-induced δ rays with a measurement of the curvature distribution of beam tracks. The method is described in detail.

539.12

5587 MESON–NUCLEON SCATTERING AT LARGE ORBITAL MOMENTS. A.D.Galanin.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 243-7 (Jan., 1960). In Russian.

The πn-scattering phases at large orbital moments are described in terms of the $\pi\pi$-interaction constant. If the results obtained are extended to the case of $I = 2$, with the assumption that at low energies the $\pi\pi$-scattering amplitudes is not resonant, disagreement with experimental data is observed.

539.12

5588 PION–NUCLEON SCATTERING. J.Ashkin.

Nuovo Cimento Suppl., Vol. 14, No. 2, 221-41 (1959).

A review is given of pion–nucleon scattering at energies below the meson production threshold. The consequences of charge independence are discussed and expressions obtained for the cross-sections in terms of s and p phase shifts. The experimental information on these phase shifts is given and compared to theoretical predictions based on static nucleon theory and on dispersion relations. E.J.Squires

539.12

5589 RECOIL PROTON POLARIZATION FROM 225 MeV π^-–p SCATTERING. J.F.Kunze, T.A.Romanowski, J.Ashkin and A.Burgers.

Phys. Rev., Vol. 117, No. 3, 859-68 (Feb. 1, 1960).

π^-–mesons of energy 225 MeV were scattered from liquid hydrogen. The polarization of the recoil proton was measured at two angles. For analysing the polarization, a counter-controlled cloud chamber was used. Recoil protons, which experienced scatterings in a carbon plate of the cloud chamber, were photographed stereoscopically. The pictures were later projected, and the necessary measurements of the scattering were made directly in three dimensions. The computed polarizations are -0.13 ± 0.16 at a laboratory recoil angle of 15°, and $+0.36\pm0.29$ at 31°. The positive sign is for polarization in the direction of the vector cross product of the incident pion momentum and the recoil proton momentum. A comparison of the data is made with various sets of scattering phase shifts which represent the differential cross-section data equally well. The results favour the Orear type of Fermi set in which the S-wave α_1 phase shift is positive.

539.12

5590 π^+–p SCATTERING AND PHASE-SHIFT ANALYSIS AT 310 MeV. J.H.Foote, O.Chamberlain, E.H.Rogers, H.M.Steiner, C.Wiegand and T.Ypsilantis.

Phys. Rev. Letters, Vol. 4, No. 1, 30-3 (Jan. 1, 1960).

Results are reported for measurements of the differential cross-section, total cross-section, and polarization of the recoil proton in π^+–p scattering at a laboratory energy of 310 MeV. A phase-shift search in terms of S, P, and D waves was made using an IBM 704 computer. Five statistically probable solutions were found. Two could be eliminated from the sign of the Coulomb interference, and a third because it was of the Minami type. The remaining Fermi type solution (a) was about 10 times more probable than the other Yang type solution (d). Also the latter type do not obey the dispersion relations. Solution (a) is in agreement with dispersion relations ($f^2 = 0.08$) and with other experimental results. Errors in the phase shifts are between 0.5° and 1.7°. Values of the D wave phase shifts, when compared with the predictions of dispersion relations, suggest the pion–pion interaction is not negligible. A.Ashmore

539.12

5591 PROOF OF DISPERSION RELATIONS FOR PION–HYPERON SCATTERING. Y.S.Jin.

Nuclear Phys., Vol. 15, No. 1, 102-7 (Feb. [1], 1960).

Proof of dispersion relations for elastic and inelastic pion–hyperon scattering $Y_1 + \pi_1 \rightarrow Y_2 + \pi_2$ (where Y is Λ- or Σ-hyperon) is presented. Though the mass-difference $M_\Sigma - M_\Lambda$ gives rise to a small unphysical region which survives even for the forward scattering, the method of Lehmann (Abstr. 2079 of 1959) and Oehme and Taylor (Abstr. 4945 of 1959) allows dispersion relations for these processes up to a momentum-transfer $2\mu^2$ or $3\mu^2$ to be derived.

539.12

5592 STOPPING OF π^--MINUS AND K-MINUS MESONS ON HYDROGEN IN NUCLEAR EMULSION. G.A.Baker, Jr.

Phys. Rev., Vol. 117, No. 4, 1130-6 (Feb. 15, 1960).

It is shown that the experimentally observed fact that the

number of K^- mesons stopping on hydrogen in nuclear emulsion is significantly larger than the number of π^- is consistent with other known properties of these mesons. The reason is chiefly that the zero energy n^-–p cross-section is anomalously low.

539.12

5593 PARITY NON-CONSERVATION IN PION PRODUCTION. D.Lurié and E.A.Power.

Nuovo Cimento, Vol. 14, No. 5, 1145-8 (Dec. 1, 1959).

Using the method of Weizsäcker–Williams the pion production asymmetry is calculated in the scattering of pions on oriented nucleons due to a possible parity violation in the pion–nucleon interaction. An upper bound for the asymmetry is obtained using the upper bounds for the parity violation in pion–nucleon scattering calculated by Fubini and Walecka in the assumption of the maximum parity violation in K-production. The result obtained is not inconsistent with the result of a recent pion production experimental result.

539.12

5594 POSITIVE PION PRODUCTION BY POLARIZED BREMSSTRAHLUNG. R.E.Taylor and R.F.Mozley.

Phys. Rev., Vol. 117, No. 3, 835-45 (Feb. 1, 1960).

By selecting bremsstrahlung produced in a 0.003 in. aluminium radiator at a small angle from the original electron direction, a beam of polarized bremsstrahlung was obtained from the Stanford linear accelerator. The variation of the polarization and intensity with angle was studied and compared with theoretical predictions. The polarized beam was used to study π^+-meson production at 90° c.m. angle and photon energies of 242, 296, 337, and 376 MeV. The ratio of meson production along and at right angles to the electric field vector was measured and compared with the values predicted by the relativistic dispersion relation.

539.12

5595 A CHECK OF DISPERSION RELATIONS FOR PHOTOPRODUCTION OF π-MESONS.

A.M.Baldwin and B.B.Govorkov.

Nuclear Phys., Vol. 13, No. 1, 193-203 (Oct. [1], 1959).

Experimental data on photoproduction of π-mesons in the near-threshold region are analysed and their essential discrepancy with the photoproduction amplitudes obtained by Chew et al. (Abstr. 7438 of 1957) is revealed. A more detailed study of dispersion relations shows that, apart from these amplitudes, the dispersion relations themselves, obtained earlier (Abstr. 3727, 4783, 7438 of 1957; 5371 of 1958) contradict experimental data, if one uses the assumption that the amplitudes approach zero sufficiently rapidly at high energies.

539.12

5596 THE PREDICTION OF THE PHOTOPRODUCTION OF π^+ BY THE DISPERSION METHOD.

K.Dietz and G.Höhler.

Z. Naturforsch, Vol. 14a, No. 11, 994-6 (Nov., 1959). In German.

The small phases ignored in Chew's photoproduction theory (Abstr. 7438 of 1957) are taken into account. A good fit to the experimental energy distributions at 90° and 150° is shown, and it is concluded that there is no firm evidence for a serious discrepancy between the experimental results and the predictions of the dispersion method. J.A.Evans

539.12

5597 SEMIPHENOMENOLOGICAL ANALYSIS OF THE PROCESS $p + p \rightarrow d + \pi^+$ NEAR THRESHOLD.

A.E.Woodruff.

Phys. Rev., Vol. 117, No. 4, 1113-18 (Feb. 15, 1960).

A semiphenomenological calculation of the amplitudes for the process $p + p \rightarrow d + \pi^+$ near threshold is presented, using phenomenological nuclear wave-functions. The meson is produced by the usual static p-wave interaction and the resulting Galilean invariant s-wave interaction. P-wave and s-wave rescattering of the meson are included. Agreement with experiment is obtained for both p-wave production amplitudes. The Galilean-invariant interaction is insufficient to yield the observed s-wave production but the contribution of the s-wave rescattering, while not well determined, is of sufficient magnitude.

539.12

5598 ANALYSIS OF A HIGH ENERGY NUCLEAR INTERACTION IN EMULSION CHAMBER. S.Hasegawa.

Nuovo Cimento, Vol. 14, No. 5, 909-30 (Dec. 1, 1959).

A high-energy jet shower of primary energy exceeding 10^{14} eV found in emulsion chamber is fully analysed. The distribution of the transverse momentum of secondary π^0-mesons was measured and the mean value of 450 MeV/c obtained. The emission angle dependence of the transverse momentum of decayed γ-rays of π^0-mesons was examined by two different methods, and appreciable change of the transverse momentum by the emission angle could not be found. The angular distributions of both charged secondary and π^0-meson is compared and no noticeable change is found. The cascade shower function in the emulsion chamber in the early stage of the development of the cascade shower is constructed experimentally for the purpose of the energy determination of the decayed γ-ray of the π^0-meson. Finally, the feature of the total structure function with many different γ-ray sources is studied, and, from this analysis, the energy converted to soft component of the jet shower and the average multiplicity of the γ-rays can be determined.

539.12

5599 SOME MEASUREMENTS ON τ MESONS. D.Prasad Dubey.

J. sci. Res. Banaras Hindu Univ., Vol. 8 (2) 145-7 (June, 1958).

Measurements are reported on two τ mesons decaying in a photographic emulsion. S.J.Goldsack

539.12

5600 DECAY OF A TAU-MESON UNDERGROUND. A.M.Short.

Nature (London), Vol. 184, 893-4 (Sept. 19, 1959).

This event was found in a scan of 38 cm^3 of emulsion exposed for 97 days at 57 m water equivalent. Also found were 231 $\mu^\pm$, 22 $\pi^\pm$ and 19 nucleon stars. R.H.W.Johnston

539.12

5601 SPECTRAL REPRESENTATIONS FOR SOME VERTEX PARTS. I.T.Todorov and O.A.Khrustalev.

Nuclear Phys., Vol. 13, No. 5, 675-84 (Nov. (3), 1959).

Spectral representations for the amplitudes describing the decay of K-mesons and hyperons into two kinds of strongly interacting particles are derived. The singular integral equations for the amplitudes obtained in the "single-meson" approximation are solved by the method suggested by Muskhelishvili (1946).

539.12

5602 THE MEAN LIFE TIME RATIO OF K^+ - MESON AND HYPERONS AND THEIR BRANCHING RATIOS OF DIFFERENT DECAY MODES.

W.T.Lee, D.C.Sen, T.H.Ho, J.M.Chen and H.Y.Tzu.

Science Record (China), New Series, Vol. 3, No. 1, 35-9 (Jan., 1959).

These ratios are calculated assuming a form of universal V-A Fermi interaction by using perturbation theory for the strong interactions. Non-leptonic K-meson decay rates are not calculated. J.C.Taylor

539.12

5603 $K^- - K^0$ RELATIVE PARITY DETERMINATION FROM NUCLEON–ANTINUCLEON ANNIHILATION.

S.N.Biswas and L.K.Pandit.

Nuclear Phys., Vol. 13, No. 2, 235-8 (Oct. (2), 1959).

It is suggested that the S_1-violating production process $\bar{p} + n \rightarrow K^- + K^0$ may lead to a definite conclusion whether or not the relative $K^- - K^0$ parity is sold.

539.12

5604 ON THE SYSTEMATICS OF ELEMENTARY PARTICLES. O.Klein.

Ark. Fys., Vol. 16, Paper 17, 191-6 (1959).

Proposes an extension of the π–N isobaric spin scheme to include K-mesons and Λ-hyperons. Other hyperons are taken to be compound particles. Also suggests an analogous scheme for weak interactions. R.J.N.Phillips

539.12

5605 HYPERCHARGE INDEPENDENCE OF K INTERACTIONS. N.Dallaporta and V.De Santis.

Nuovo Cimento, Vol. 14, No. 1, 225-32 (Oct. 1, 1959).

Further discussion is given of the generalized Dirac equation satisfied by a 32 component spinor, which is intended to describe all baryons (Abstr. 1244 of 1960). In particular, rotations in the 4-dimensional hypercharge space are considered. Two sets of 3-dimensional rotations in this space are introduced, and these give rise to the "hypercharge" and "hypernumber" operators. Some consequences of this classification for K-meson interactions are discussed. E.J.Squires

539.12

5606 ON THE INTERPRETATION OF THE K^--MESON INTERACTION IN NUCLEAR EMULSION.

U.Kundt, K.Lanius and K.Lewin.
Nuovo Cimento, Vol. 14, No. 5, 943-50 (Dec. 1, 1959).

Observed frequencies of pions emitted by K^- captures at rest in nuclear emulsion are used for an estimation of the percentage of 1π interactions. It is shown that a value of 20% is an upper limit for the percentage of 2π interactions. Simultaneously it turns out that the capture must occur preferentially at the nuclear surface. A branching ratio is determined for the production of different kinds of hyperons in the 1π interactions.

539.12

5607 K^+ SCATTERING IN THE ENERGY RANGE 100-250 MeV. D.F.Davis, N.Kwak and M.F.Kaplon.
Phys. Rev., Vol. 117, No. 3, 846-9 (Feb. 1, 1960).

Approximately 65 m of K^+–meson track was scanned in the energy interval 100-250 MeV. Analysis of the data shows that the K^+–neutron charge exchange scattering rises appreciably above the value $\frac{1}{9}$ corresponding to a pure I = 1 interaction and at energies $>\sim$150 MeV appears to be larger than the K^+–neutron direct scattering. Analysis of the angular distribution of the inelastic events for K^+ incident energies greater than 150 MeV indicates a nonisotropic centre-of-mass angular distribution, peaked towards $\theta_{c.m.} = 180^\circ$

539.12

5608 K^--MESON ELASTIC SCATTERING BY EMULSION NUCLEI. D.F.Davis, N.Kwak and M.F.Kaplon.
Phys. Rev., Vol. 117, No. 3, 850-3 (Feb. 1, 1960).

Data on elastic nuclear scattering of K^--mesons in emulsion were obtained. The differential cross-section was calculated by the WKB approximation in the method of partial waves. It is concluded that the real and imaginary potentials necessary to give the correct K^-–nucleon cross-section also give a good fit to the elastic nuclear scattering data.

539.12

5609 ELASTIC SCATTERING OF K^- MESONS BY NUCLEI. P.B.Jones.
Phys. Rev. Letters, Vol. 4, No. 1, 35-6 (Jan. 1, 1960).

Ilford K.5 nuclear emulsion was exposed to the 435 MeV/c K^- beam of the Bevatron. Scanning of 23 m of track gave a mean free path for inelastic collisions in the interval 144-106 MeV of $30.7^{+4.0}_{-3.3}$ cm. Elastic scatterings were divided into intervals of momentum transfer. The results were compared with an exact numerical solution of the Klein–Gordon equation. The most probable value for the optical model potential is –(30-37i) MeV but there is a considerable range of possibilities. This result is consistent with the (a+) and (b+) S-state scattering length solutions for K^-–nucleon scattering (Abstr. 379 of 1959). A.Ashmore

539.12

5610 K–HYPERON PRODUCTION THRESHOLD PHENOMENA. L.Fonda and R.G.Newton.
Nuovo Cimento, Vol. 14, No. 5, 1027-50 (Dec. 1, 1959).

The energy dependence of pion-proton scattering and K-meson hyperon production cross-sections is studied on the basis of a simple model. It is found that the threshold effects can be big enough to be experimentally detectable for the purpose of determining relative hyperon and K-meson parities.

Hyperons

539.12

5611 EFFECT OF NON-LOCALITY IN FERMI INTERACTIONS DUE TO VECTOR MESONS ON THE DECAYS $\Sigma \to p + \gamma$ AND $\mu \to e + \nu + \bar{\nu}$. P.Prakash and A.H.Zimerman.
An. Acad. Brasil Cienc., Vol. 31, No. 2, 163-70 (1959).

Under the assumption that the Fermi interactions are mediated through charged vector mesons, it is found that the branching ratio of $\Sigma \to p + \gamma$ to $\Sigma \to p + \pi^0$ can be of the order of 10^{-4}, and for muon decay the Michel parameter can be less than $\frac{3}{4}$ if the vector meson mass exceeds ten proton masses. P.K.Kabir

539.12

5612 DECAY MODE AND LIFETIME OF Σ^+ IN EMULSIONS AND SOME REMARKS ABOUT THE $\Sigma^\pm$-LIFETIME. W.Koch, M.Nikolic, M.Schneeberger and H.Winzeler.
Helv. phys. Acta, Vol. 32, No. 6-7, 549-58 (1959).

Reports the lifetimes of Σ^+ and $\Sigma^\pm$-hyperons obtained from 1600 K^--interactions in emulsions. In agreement with other emulsion data, the lifetime of the fast Σ's, which arise mostly from multi-nucleon reactions, seems to be different from the lifetime of Σ's produced in Σ-nucleon reactions. Two possible explanations of this discrepancy are considered: (a) the difference between the results is due to several experimental biases; (b) the results are taken at face value and the possibility of a real physical reason is taken into account. Suggestions are made on how to decide between the two alternatives.

539.12

5613 PROTONIC DECAY OF A Σ^+ HYPERON WITH AN ASSOCIATED ELECTRON PAIR. L.Rob and Z.Korbel.
Nuclear Phys., Vol. 13, No. 2, 300-1 (Oct.[2], 1959).

The Σ^+ hyperon was emitted from a star produced by K^- meson capture at rest; one π^- meson and a recoil was observed simultaneously. The hyperon after travelling 890 μ decayed in flight into a proton and an electron pair. The proton energy, (29.4 ± 0.5) MeV, was estimated from the range. The event is interpreted as a decay of a Σ^+ hyperon in flight according to the scheme $\Sigma^+ \to p + \pi^0$. The most probable explanation of the electron pair is that it arises from the internal conversion of one of the two photons in the normal decay of the π^0 meson.

539.12

5614 THE ANGULAR DISTRIBUTION OF THE DECAY PRODUCTS OF HYPERONS.
J.M.Chen, T.H.Ho, D.C.Sen and H.Y.Tzu.
Science Record (China), New Series, Vol. 3, No. 1, 31-4 (Jan., 1959).

Assuming various forms for the interaction Hamiltonian responsible for the decay process, the angular distributions of the decay products are calculated and compared with experiment.
P.K.Kabir

539.12

5615 ON THE SPIN OF THE Σ-HYPERON. S.Hori.
Nuclear Phys., Vol. 15, No. 1, 56-9 (Feb. (1), 1960).

The large asymmetry factor observed in the decay of the Σ^+-hyperon indicates that the spin J of the hyperon is either $\frac{1}{2}$ or $\frac{3}{2}$, when an inequality derived by Lee and Yang (1958) is taken into consideration. Nevertheless, the distribution function in the case of $J = \frac{3}{2}$ manifests a quite different behaviour from that for $J = \frac{1}{2}$ when it is calculated taking into account the observed large value of the asymmetry factor. Thus, if the corresponding distribution curve could be measured experimentally, it would not be difficult to determine the spin of the Σ-hyperon.

539.12

5616 POLARIZATION OF Λ^0 FROM PHOTOPRODUCTION IN HYDROGEN.
B.D.McDaniel, P.Joos, D.McLeod, S.Richert and D.Zipoy.
Phys. Rev. Letters, Vol. 4, No. 1, 33-5 (Jan. 1, 1960).

A 3 in. long liquid hydrogen target was placed in the beam of the Cornell synchrotron, operating at 1080 MeV. K-mesons from the reaction $\gamma + p \to K + \Lambda^0$ were magnetically selected in the interval 515 ± 60 MeV/c. The counter system was arranged for the simultaneous detection of K-mesons, and protons from the Λ^0 decay. Proton counters above and below the beam were used to measure the asymmetry. About 14% of the coincidences were random. Assuming the Λ^0 spin is $\frac{1}{2}$, a proton distribution $(1 + \alpha \cos\theta)$ with respect to the Λ^0 spin, and a Λ^0 polarization perpendicular to the K,Λ plane it is found that $\alpha P = 0.04 \pm 0.11$. Taking $\alpha > 0.73 \pm 0.14$ (Steinburger), this gives P (32° c. of m.) < 0.05 ± 0.15. This, along with isotropy and energy dependence near threshold, is consistent with S-wave production. A.Ashmore

539.12

5617 PRODUCTION OF Σ^0 AND Λ HYPERONS BY Σ^- CAPTURE IN DEUTERIUM.
O.Dahl, N.Horwitz, D.Miller and J.Murray.
Phys. Rev. Letters, Vol. 4, No. 2, 77-8 (Jan. 15, 1960).

Using Σ^- hyperons produced by K^- mesons in a deuterium bubble chamber by the reaction $K^- + d \to \Sigma^- + \pi^+ + n$, the branching ratio $\Gamma(\Sigma^0)/\Gamma(\Sigma^0 + \Lambda)$ was measured for the reactions $\Sigma^- + d \to \Sigma^0 + n + n$ and $\Sigma^- + d \to \Lambda + n + n$. The momenta of Λ's produced by absorption of Σ^- were measured and used to identify the reaction taking place. The branching ratio was found to be 0.037 ± 0.022, in agreement with the predictions of Day et al (Abstr. 12602 of 1959).
C.J.Batty

539.12

5618 SOME SYMMETRY PROPERTIES OF ANTIHYPERON PRODUCTION PROCESSES WHICH ARE CONNECTED WITH ANTINUCLEON ANNIHILATION.

Chzou Guan-Chzhao. [Chou Kuang-Chao].

Zh. eksper. teor. Fiz., Vol. 36, No. 3, 938-9 (1959). In Russian.

By assuming invariance under charge-conjugation and isobaric rotations, various relations between the transition amplitudes of the processes of the type

$$N + \bar{N} \rightarrow Y_1 + \bar{Y}_2 + m\pi^+ + n\pi^- + l\pi^0$$

are established. P.Roman

Strange particles

539.12

5619 STRANGE PARTICLES. J.Ashkin.

Nuovo Cimento Suppl., Vol. 14, No. 2, 310-27 (1959).

The Gell-Mann–Nishijima classification of strange particles in terms of the strangeness quantum number is discussed, and shown to be in accord with experiments on the production and decay of strange particles. The available data (1958, with later additions) is discussed in more detail and shown to indicate spin $\frac{1}{2}$ for the $\Lambda_\circ$ and to yield evidence of parity violation in strange particle decays. E.J.Squires

Deuterons

539.12

5620 MAGNETIC MOMENT OF THE DEUTERON. H.D.Young and R.E.Cutkosky.

Phys. Rev., Vol. 117, No. 2, 595-604 (Jan. 15, 1960).

A contribution to the deuteron magnetic moment which results from the altered expectation values of nucleon core spins in the bound state is calculated. The adiabatic approximation, in which the π-meson clouds of a static-nucleon model are assumed to follow the orbital motion of the sources, is used. The two-nucleon states are expanded in Heitler–London states; the expectation value of the deuteron magnetic moment operator is related to single-nucleon matrix elements by means of an expansion corresponding to exchange of various numbers of mesons between the nucleons. The single-nucleon matrix elements are evaluated using the Chew–Low–Wick fixed-source theory. If an orbital wave-function with a relatively large D-state probability is used, the one-meson exchange terms give an increase in the deuteron magnetic moment of about 1%. The two-meson exchange terms are considerably smaller than the one-meson exchange terms.

539.12

5621 DEUTERON MAGNETIC MOMENT AND MOMENTUM DEPENDENCE OF TWO-NUCLEON POTENTIAL. M.Sugawara.

Phys. Rev., Vol. 117, No. 2, 614-15 (Jan. 15, 1960).

The correction to the deuteron magnetic moment [μ_d] is calculated, in the manner pointed out by Feshbach, for the potential derived by Sugawara and Okubo from pion field theory Abstr. of 1960 . This potential includes, besides an L·S potential, a quadratic term, $-V_s(r)(p^2/2k^2) + \text{H.c.}$ [$V_s(r)$ being the second-order static potential, p and k the nucleon (relative) momentum and rest mass, respectively]. It is shown in particular that this new term gives a positive correction to μ_d. Numerical magnitudes are estimated using phenomenological deuteron wave-functions fitted to all known deuteron data, the hard-core radius [r_C] and the D-state probability [P_D] being adjustable parameters. Results are shown graphically as functions of P_D for two values of r_C. It is seen that the corrections depend sensitively on these two parameters. If there were no other appreciable corrections to μ_d than those discussed here, ps–ps theory would lead to 6% for P_D, while μ_d would not be fitted in the ps–pv case as well as for the Gammel–Thaler potential, since the correction due to the quadratic term is not large enough to cancel the correction due to the L·S potential.

539.12

5622 MOMENTUM SPACE REPRESENTATION AND PHOTODISINTEGRATION OF THE DEUTERON. K.S.Suh.

Amer. J. Phys., Vol. 28, No. 4, 327-32 (April, 1960).

The momentum space representation is discussed in general and an application is made, deriving the cross-section of the photodisintegration of the deuteron, using the Hulthen wave function. The theoretical results are compared with the experimental values, and the Hulthen wave function parameter is determined.

539.12

5623 LOW-ENERGY DEUTERON PHOTODISINTEGRATION. G.Kramer and D.Müller.

Z. Phys., Vol. 156, No. 2, 204-13 (1960). In German.

On the basis of a phenomenological theory of the photodisintegration process, the differential cross-section and the polarization of the final state nucleons are calculated. The D-state admixture of the ground state is taken into account. Using information from neutron–proton scattering, the dependence of the magnetic dipole transition on the force parameters is investigated in detail.

539.12

5624 DEUTERON PHOTODISINTEGRATION AND P-WAVE PHASE SHIFTS IN THE MEDIUM ENERGY RANGE. G.Kramer.

Nuclear Phys., Vol. 15, No. 1, 60-71 (Feb. [1], 1960).

The angular distribution and the parameter of the polarization of nucleons produced in deuteron photodisintegration are calculated for different phase-shift sets which fit n–p scattering data corresponding to 40 MeV, 100 MeV and 150MeV in the laboratory system. It is found that all the sets which are characterized by positive $^3P_0$ and negative $^3P_1$ phase-shifts give similar results for the angular distribution. A small polarization results from sets with a large $^3P_0$ phase-shift. For all of the sets which are characterized by a negative $^3P_0$ and a positive $^3P_1$ phase-shift, angular distributions are obtained which are outside the experimental errors, if one assumes that the D-state probability of the ground state is not extremely large.

539.12

5625 PHOTODISINTEGRATION OF DEUTERONS IN THE PRESENCE OF THE PION-THEORETICAL POTENTIAL. J.Iwadare, M.Matsumoto, S.Otsuki, R.Tamagaki and W.Watari.

Nuovo Cimento, Vol. 13, No. 6, 1263-4 (Sept. 16, 1959).

An attempt is made to justify the pion-theoretical potential, by applying it to the problem of photodisintegration of the deuteron. The E1 and M1 transitions were taken into account, and the wave-functions determined by the neutrons in an earlier paper [Suppl. Progr. theor. Phys., No. 3, Pt 2 (1956)] were used. The coefficients in the angular distribution of emitted protons, and the angular dependence of the polarization were calculated for $E\gamma$ = 22.4, 53.6 and 80.4 MeV. The angular distributions agree well with experiment and also with similar calculations using a Signell–Marshak potential. No polarization data are available, but even in this case it would be difficult to distinguish the two theories. J.A.Evans

539.12

5626 PHOTODISINTEGRATION OF THE DEUTERON WITH 94 MeV BREMSSTRAHLUNG RADIATION. J.A.Galey.

Phys. Rev., Vol. 117, No. 3, 763-72 (Feb. 1, 1960).

Differential cross-sections for the reaction $\gamma + d \rightarrow p + n$ were determined at laboratory angles of 45°, 75°, 90°, and 135° for laboratory photon energies from approximately 50 to 90 MeV. At each of the above angles the energy spectrum of the recoil protons was determined with a counter telescope and a pulse-height analysis system. The low cross-section for this reaction necessitates the reduction of background to a minimum. This was accomplished by the use of a gaseous target and a particle selection technique. The differential cross-sections and the estimates of the parameters describing angular distributions are in reasonable agreement with recent calculations by de Swart and Marshak and by Zernik, Rustgi, and Breit.

Alpha-particles

539.12

5627 ALPHA-PARTICLE S-STATE BINDING ENERGY. L.Cohen and J.B.Willis.

Nuclear Phys., Vol. 13, No. 1, 125-31 (Oct. (1), 1959).

A variational calculation has been made of the principal S-state contribution to the binding energy of the alpha-particle using a Yukawa interaction and a radial wave-function of the form

$\exp(-\mu\Sigma_{i<j}r_{ij})$. The results show a substantial improvement on earlier calculations with a radial wave-function of the form $\exp[-\mu(\Sigma_{i<j}r_{ij}^{2})^{\frac{1}{2}}]$. The methods used are such that extension to include hard-core interactions would be very straightforward. Monte-Carlo methods are used to evaluate the integrals.

539.12

5628 ALPHA–ALPHA SCATTERING IN THE RANGE 36.8 TO 47.3 MeV.

H.E.Conzett, G.Igo, H.C.Shaw and R.J.Slobodrian.
Phys. Rev., Vol. 117, No. 4, 1075-9 (Feb. 15, 1960).

Absolute differential cross-sections for the elastic scattering of alpha particles from helium were obtained at 36.8, 38.8, 40.8, 41.9, 44.4, 46.1, 47.1, and 47.3 MeV. Measurements were made at intervals of 2° over an angular range from about 15° to beyond 90° in the centre of mass system. The angular distribution shows a single minimum of 65° at the two lowest energies, and two minima, at about 35° and 70°, at the other energies.

539.12

5629 OPTICAL MODEL ANALYSIS OF THE SCATTERING OF ALPHA PARTICLES FROM HELIUM. G.Igo.
Phys. Rev., Vol. 117, No. 4, 1079-85 (Feb. 15, 1960).

An optical model analysis using a complex potential

$$\frac{V + iW}{1 + \exp[(r-r_{o})/d]}$$

has been made of the elastic scattering of alpha particles from helium. In the data which is analysed, the bombarding energy ranges from 23.1 to 47.1 MeV. The best arrangement with the angular distributions taken at eight different bombarding energies was obtained when the parameters V, W, r_{o}, and d were −112 MeV, −1 MeV (for bombarding energies near 40 MeV), 1.8×10^{-13} cm, and $0.6 \pm 0.1 \times 10^{-13}$ cm, respectively. The value −112 MeV for V is an average value; V decreases by 15% when the bombarding energy is increased from 23 to 47.1 MeV. Since W is small, the central depth of the real part of the potential V has significance. This is in contrast to the scattering of alpha particles from heavier elements where the absorption is so large that the central part of the potential is not easily determined. No lower limit was placed on r_{o}, however, r_{o} must be less than 2.7×10^{-13} cm. The phase shifts obtained from this analysis are in good agreement with the preliminary results of Snyder below 42 MeV. Above 42 MeV they continue to vary slowly with no new states of Be^{8} appearing up to 47.1 MeV.

539.12

5630 ROOM TEMPERATURE OPERATED P–N JUNCTIONS AS CHARGED PARTICLE DETECTORS.

S.S.Friedland, J.W.Mayer, J.M.Denney and F.Keywell.
Rev. sci. Instrum., Vol. 31, No. 1, 74-5 (Jan. 1, 1960).

The performance of two p–n junctions as α-particle detectors is described. These were made from 10 ohm cm p-type silicon with a diffused phosphorus n-layer parallel to the active surface in one case 12μ, and in the other case, 1μ below it. Graphs of pulse-height versus α-particle energy are shown for both counters and also energy spectra for the one with the thicker surface layer.

R.E.Meads

COSMIC RAYS

(Nuclear reactions due to cosmic rays are included under Nuclear Reactions)

537.59

5631 COSMIC NEUTRINO RADIATION. G.Marx and W.Menyhárd.
Science, Vol. 131, 299-300 (Jan. 29, 1960).

New and more powerful methods for eliminating background intensity are needed in order to make possible the development of neutrino astronomy into a new, far-reaching branch of science.

537.59

5632 ON SYSTEMATIC ERRORS IN THE LEAST SQUARES REGRESSION ANALYSIS, WITH APPLICATION TO THE ATMOSPHERIC EFFECTS ON THE COSMIC RADIATION.
H.Trefall and J.Nordö.
Tellus, Vol. 11, No. 4, 467-77 (Nov., 1959).

It is shown that if the variables employed in a least squares regression analysis are subject to random errors of measurement, the expectation values of the partial regression coefficients, of the partial correlation coefficients and of the multiple correlation coefficient may all differ from those which would have existed, had no errors been present. If there is no intercorrelation between the errors of different variables, random errors in a given variable always reduce the numerical expectation values of the corresponding partial regression and correlation coefficients. Coefficients corresponding to other variables may, however, be influenced in either direction depending on the intercorrelations between the variables. The expectation value of the multiple correlation coefficient is reduced by errors in any variable. The general case, in which the errors of different variables are intercorrelated, is also briefly discussed. The problem of determining the atmospheric effects on the cosmic radiation is then discussed. It is shown that some previously unexplained discrepancies between empirical and theoretical estimates, and also between empirical estimates obtained from the study of day-to-day variations, and such obtained from the seasonal variations of the cosmic-ray intensity, are probably due to systematic effects of random errors in the aerological data employed in the regression analysis. Estimates of error variances and covariances of aerological data from the upper troposphere and the lower stratosphere have been obtained by analysing differences between data from two closely situated stations on Spitzbergen. They have then been used to obtain corrected estimates of the cosmic-ray atmospheric effects, which are now found to agree fairly well with the theoretical ones.

537.59

5633 LATITUDE EFFECT ON EXTENSIVE AIR SHOWERS OF COSMIC RAYS. S.Ozaki.
Phys. Rev., Vol. 117, No. 4, 1125-7 (Feb. 15, 1960).

The variation of air shower counting rate with latitude was measured between 7° and 50°N at sea level. The observed showers have 10^{6} charged particles on the average. Within the statistical accuracy, a few percent, no latitude effect on the intensity was obtained.

537.59

5634 ON THE PENETRATING COMPONENT OF EXTENSIVE AIR SHOWERS (E.A.S.). R.E.Kazarov and R.B.Lyudvigov.
Zh. eksper. teor. Fiz., Vol. 35, No. 5 (11), 1310-11 (1958). In Russian. English translation in: Soviet Physics–JETP (New York), Vol. 8, No. 5, 915-16 (May, 1959).

This was studied at 127 m water equivalent (w.e.) using 2 detectors, one directly under an e.a.s. system, the other 45 m away. Comparison with a similar experiment at 61 m.w.e. enables the exponent γ of the energy spectrum at 46 m from the shower axis to be determined:

$$\rho_{\mu}(>E) = A(E + 1.5)^{-\gamma} \qquad \gamma = 1.15 \pm 0.41$$

The data is also used to determine the parameters of an assumed lateral distribution

$$\rho_{\mu}(r) = a \exp[-\alpha r^{2}]:$$

$$a = 0.34 \pm 0.01, \quad \alpha = 0.0074 \pm 0.00011$$

R.K.W.Johnston

537.59

5635 FIRST AND SECOND HARMONICS OF THE DAILY VARIATION OF THE COSMIC RAY NUCLEONIC COMPONENT AT UPPSALA AUG. 31, 1956 TO AUG. 31, 1957.
A.E.Sandström and S.Lindgren.
Ark. Fys., Vol. 16, Paper 12, 137-51 (1959).

The neutron pile monitor in Uppsala has 12 proportional counters with 97% enriched $B^{10}F_{3}$, giving an average counting rate of 420 counts/minute (Aug. 1956). In the present paper the recordings from the first year of running are treated as regards the daily variation. The mean daily variation for every single rotation period is treated, as well as the mean daily variation for the whole year. To study the correlation with geomagnetic activity the days were divided into five classes according to their K_{p}-indices. The first and second harmonics for each class of days were determined for the period from 31 Aug. 1956 to 31 Aug. 1957. The disturbing influence of the sharp intensity drop following the onset of a Forbush decrease is discussed. The influence is found to be negligible not only as far as the yearly mean is concerned, but also as regards the 27 days solar rotation periods. The influence becomes serious only in the case of the most disturbed days when phase and amplitude are studied as

functions of the K_p-indices. The mean value of the time of maximum is found to be 1300 G.M.T. for the first harmonic and 0530 G.M.T. for the second harmonic. The yearly mean of the amplitude is 0.32% in the first case and 0.034 % in the second. The dependence of phase and amplitude on the K_p-index is very small.

537.59

5636 THREE VARIATIONS IN THE INTENSITY OF COSMIC RADIATION IN THE FIRST HALF OF 1958.

J.Hladký, P.Chaloupka, V.Kadečka, T.Kowalski and P.Mokrý.
Czech. J. Phys., Vol. 9, No. 4, 432-8 (1959).

The preliminary results of measurements taken during three variations in the intensity of cosmic radiation during the first half of 1958 are given. Measurements were made of the intensities of mesons and neutrons at two stations, one at an altitude of 2634 m above sea-level and a geomagnetic latitude of 48°N, the other at an altitude of 228 m above sea-level and the same latitude. Details of the apparatus are given and the particle energies are estimated.

C.F.Barnaby

537.59

5637 NORTH-SOUTH ANISOTROPY AND ANTICIPATORY INCREASE OF INTENSITY ASSOCIATED WITH THE COSMIC-RAY STORM OF FEBRUARY 11, 1958.

V.Sarabhai and R.Palmeira.
Nature (London), Vol. 184, 1204-7 (Oct. 17, 1959).

The cosmic-ray effects associated with the Forbush decrease of Feb. 11, 1958, are discussed on the basis of data obtained from a meson detector at the Massachusetts Institute of Technology and from a grid of neutron detectors. The fifteen stations forming the grid were distributed (a) in two belts corresponding to the equator and the middle geomagnetic latitudes, (b) in three meridional sections corresponding to 75°-115°W, 0°-32°E and 147°-168°E and (c) in the northern and southern hemispheres. In addition details are given of the important solar events and terrestrial effects associated with the decrease. From the analysis of all the results it is concluded that in the two increases and the main decrease observed with the cosmic-ray storm there were essentially three types of modulation process. One was directly associated with the moving plasma, probably related to the magnetic fields in the shock front and gave increases as well as decreases of intensity along with anisotropy. The second gave decreases of intensity and was related to a process which has a sharp onset but a relatively long time constant of recovery.

C.F.Barnaby

537.59

5638 EVIDENCE FOR COSMIC RAY ENERGY SPECTRUM CHANGES DURING A FORBUSH DECREASE.

K.W.Ogilvie and M.M.Winn.
Nature (London), Vol. 184, 888-9 (Sept. 19, 1959).

During the Forbush decrease which started on May 10, 1959, and for some time previously, the Sydney neutron monitor was set up to study changes in the multiplicity of neutron production, which, though not a rapidly varying function of energy, might be expected to be determined by the spectrum of incident particles. The monitor was operated underground at a depth of about 60 m water equivalent of rock. Although statistics were not good the results indicated that the mechanism of the decrease was such that the monitor counting rate was lowered by removing particles from the low-energy end of the cosmic-ray spectrum, which agrees with work on the dependence on latitude of Forbush decreases. It seems likely that the interactions in the monitor during the decrease were of higher than average multiplicity, corresponding to an increased proportion of high energy incident particles.

C.F.Barnaby

537.59

5639 AN INTERPRETATION OF THE SOLAR ANISOTROPY OF PRIMARY COSMIC RADIATION. N.W.Nerurkar.
Proc. Indian Acad, Sci. A, Vol. 45, No. 5, 341-60 (May, 1957).

The present state of knowledge concerning the daily variation of meson intensity is reviewed. An attempt is made to interpret the occurence of a variable anisotropy of cosmic radiation to which are attributed the principal experimental observations. It is suggested that the variable anisotropy is due to beams of solar ionized matter with a frozen magnetic field derived from the magnetic field of the active solar regions and bears no preferential orientation in respect of the solar dipole field. With the strength of the component of the magnetic field perpendicular to the solar equitorial plane in the range 10^{-4} to 10^{-6} G and the velocity of the beam between 500 and 2000 km sec^{-1} the daily variation of meson intensity has amplitudes from 0.3 to 1.5%. The simultaneous presence of two such beams gives rise to double the amplitudes or a daily variation with two maxima. Some further aplications of the theory are discussed.

C.F.Barnaby

537.59 : 523.16

RELATION BETWEEN THE EMISSION OF COSMIC RAYS FROM THE SUN AND BURSTS OF TYPE IV. See Abstr. 4658

537.59

5640 MEAN FREE PATH OF NUCLEAR INTERACTION IN Pb AND Al OF SECONDARY PARTICLES OF COSMIC RAY SHOWERS. Lü Min.
Science Record (China), New Series, Vol. 3, No. 2, 71-8 (Feb., 1959).

The mean free paths in lead and aluminium of the secondary particles of cosmic radiation were determined with a multiplate cloud chamber at a height of 3185 metres. The results indicated that each secondary particle of the cosmic ray shower has an average available energy of 1 GeV. The interaction mean free paths in Pb and Al were found to be 177 ± 16 g cm^{-2} and 100g cm^{-2} respectively (the geometrical cross-sections are 187 and 95 respectively). Proton interactions contributed about 13% of the total number produced by charged particles. Assuming that there were only π mesons other than protons among the charged particles the proton to π meson ratio was about 15%. A total of 142 nuclear interactions produced by secondaries were analysed.

C.F.Barnaby

NUCLEUS

539.14

5641 THE GREEN'S FUNCTION OF ODD NUCLEI. Yu.T.Grin', S.I.Drozdov and D.F.Zaretskii.
Zh. eksper. teor. Fiz., Vol. 36, No. 1, 222-6 (Jan., 1960).
In Russian.

The many-body theory is applied to a study of pair correlation in finite systems with an odd number of particles. The Green's function is found and the perturbation theory developed.

539.14

5642 BRUECKNER THEORY AND THE SHELL MODEL EFFECTIVE POTENTIAL. E.J.Squires.
Nuclear Phys., Vol. 13, No. 2, 224-34 (Oct.(2), 1959).

A discussion is given of the properties of the shell model effective potential obtained from Brueckner theory. Correction terms to the simple picture, in which the effective potential is just the Brueckner t-matrix, are indicated explicitly for certain cases and their origin discussed. Analogy with known properties of the t-matrix for infinite nuclear matter suggests that some of these corrections are of importance. It is suggested that while there may be some meaning to the concept of a simple effective potential in certain situations, the idea is not of general applicability.

539.14

5643 UNSTABLE STATES AND THE SEPARABLE POTENTIAL MODEL. D.B.Fairlie and J.C.Polkinghorne.
Nuclear Phys., Vol. 13, No. 1, 132-5 (Oct. [1], 1959).

A model based on a separable potential is investigated and it is shown that the unstable states can be associated with poles of the continuation of the scattering amplitude into the second Riemann sheet.

539.14

5644 ON CORE-TO-PARTICLE INTERACTION FROM CLASSICAL POINT OF VIEW.
S.Mukherjee and A.Gupta.
Indian J. Phys., Vol. 32, No. 7, 330-5 (July, 1958).

The treatment of the extra-core particle in the semi-rigid model of the nucleus, in a core plus one particle system, in a sense, justifies the form of the interaction Hamiltonian used, in such cases, by Bohr (1952) in his collective model of the nucleus.

539.14

5645 MANY-BODY BASIS FOR THE OPTICAL MODEL. L.M.Frantz and R.L.Mills.
Nuclear Phys., Vol. 15, No. 1, 16-32 (Feb. (1), 1960).

A formal expression is derived for an optical-model potential based on an assumed two-body interaction between nucleons, which

provides an exact description of the elastic scattering of a single nucleon by a closed shell (or closed shell ± 1) nucleus. A second-quantized description is used for the many-fermion system, the true state vector being expanded in terms of a complete set of single-particle model wave-functions. Elimination of the variables of all but the scattered nucleon yields a weighting function which satisfies a one-body Schrödinger equation, whose S-matrix elements are identical with those of the true S-matrix between states corresponding to elastic scattering. The effective optical-model potential is identified from this Schrödinger equation, and is found, of course, to be complex and non-local. It contains all the effects of the exclusion principle, and is in the form of a linked-cluster perturbation expansion, so that the spurious divergence of Brillouin–Wigner perturbation theory for a large number of nucleons is absent.

539.14

5646 CONTRIBUTION TO THE ELECTROSTATIC SELF-ENERGY OF A CHARGED LIQUID DROP.

W.D.Foland.

Phys. Rev., Vol. 117, No. 4, 1037-43 (Feb. 15, 1960).

For previous work, see Abstr. 5077 (1959). The electrostatic self-energy of the liquid-drop-model nucleus has been divided into two parts, one of which has been evaluated. The problems arising due to difficulties in choosing limits of integration — difficulties which occur due to the presence in the integrand of the factor r_{12}^{-1} — are all contained in the formulation of that part of the self-energy obtained here. The evaluation of the other part of the self-energy poses no such limit problems. The shapes considered for the drop are the shapes adopted by a nucleus undergoing symmetric fission. The self-energy is expressed as a multiple-power series in the deformation parameters a_n. The part of the self-energy which is calculated is zero through the general seventh-power term in the multiple-power series for the self-energy.

539.14

5647 GROUP-THEORETICAL INVESTIGATIONS IN CONNECTION WITH THE SHELL MODEL. I. MATHEMATICAL THEORY OF THE HAMILTONIAN. M.Kretzschmar.

Z. Phys., Vol. 157, No. 4, 433-56 (1960). In German.

The harmonic oscillator shell model with LS-coupling is studied from a group-theoretical point of view. Omitting the spin and isospin, the most general transformation group which leaves the Hamiltonian invariant is determined to be the unitary group in 3A dimensions, where A is the nucleon number. The irreducible representations of this group are decomposed into those of its subgroups and it is shown that the wave functions may be classified in this way. A clear separation of the totality of wave functions is obtained into "good" and "spurious" states. P.Roman

539.14

5648 RADII OF "MIRROR" NUCLEI. G.Mouchitzky.

J. Phys. Radium, Vol. 18, No. 10, 567-71 (Oct., 1957). In French.

Using the shell model, values of nuclear radius for mirror pairs have been calculated from the experimental values of Coulomb energy differences, as was made previously by Jancovici et al. (see for example Abstr. 9504 of 1954; Abstr. 447 of 1955). The harmonic oscillator well has been taken for the over-all potential, and Slater's method was used for calculating the energy perturbation due to Coulomb forces, from A = 3 to A = 17. The ratio of Coulomb to mesonic radius, as defined by Jancovici, and the value r_0 of the elementary nuclear radius were obtained in this way. G.Mouchitzky.

539.14

5649 ON THE SPLITTING OF THE PEAK IN THE NEUTRON STRENGTH FUNCTION NEAR A = 55.

J.M.Leblanc, R.E.Coté and L.M.Bollinger.

Nuclear Phys., Vol. 14, No. 1, 120-30 (Dec. [1], 1959).

The results of neutron transmission measurements on bromine and selenium and their enriched isotopes are presented. Resonance parameters were determined for six resonances in Br^{79}, three in Br^{81}; and a total of eight in the various enriched isotopes of selenium. The values of Γ_n^0/D for Br^{79} and Se^{80} are determined from these parameters. These new values of the strength function are compared with those for neighbouring nuclides. The combined results give a clear indication that the peak in the neutron strength function near nucleon number 55 shows a splitting similar to that of the maximum near A = 155.

539.14 : 539.17

5650 AN AID IN THE DETERMINATION OF NUCLEAR SPINS. R.K.Sheline, H.L.Nielsen and A.Sperduto.

Nuclear Phys., Vol. 14, No. 1, 140-4 (Dec. [1], 1959).

Intensities of the α-groups collected in the backward angle from the $Al^{27}(d,\alpha)Mg^{25}$ reaction were analysed after recording them on nuclear emulsions over an extended range of excitation. Given intensities are determined with an average deviation of ~15%. Normalizing the intensities (by 2I + 1) and the barrier penetration factors produces intensities which are the same within an average deviation of 33%. Use of these intensities in determining spin is discussed.

539.14

5651 SPINS AND PARITIES OF LEVELS OF ^{9}Be BELOW 15 MeV. H.H.Thies and B.M.Spicer.

Austral. J. Phys., Vol. 12, No. 3, 293-6 (Sept., 1959).

From all available experimental data, spin and parities are assigned to the energy levels of Be^9: 1.7 MeV, $\frac{1}{2}$+; 2.43 MeV, $\frac{5}{2}$−; 3.05 MeV, $\frac{1}{2}$ − ($\frac{3}{2}$−); 4.8 MeV, (3 levels); 6.8 MeV, (2 levels of opposite parity); 7.94 MeV, $\frac{3}{2}$+; 9.2 MeV (existence uncertain); 11.3 MeV, $\frac{1}{2}$, $\frac{3}{2}$, $\frac{5}{2}$, +; 13.3 MeV, $\frac{1}{2}$, $\frac{3}{2}$, $\frac{5}{2}$, +. Intermediate coupling with a/K ≅ 2.75 gives odd parity levels corresponding to those at 2.43, 3.05 and 4.8 MeV. A.Ashmore

539.14

5652 NUCLEAR SPINS OF THE BISMUTH ISOTOPES Bi^{199}, Bi^{200}, Bi^{201}, AND Bi^{202}.

S.Axensten, C.M.Johansson and I.Lindgren.

The atomic beam magnetic resonance method has been used for measurements of the ground-state spins, with the following results: Bi^{199} (25 min), I = 9/2; Bi^{200} (35 min), I = 7; Bi^{201} (1.85 hr), I = 9/2; Bi^{202} (1.6 hr), I = 5. All attempts to find the 1.0 hr isomeric state in Bi^{201} have been unsuccessful. The spin values obtained are discussed from the point of view of the nuclear shell model.

539.14

5653 A DETERMINATION OF THE SPINS OF THE 3.47 AND 3.61 MeV LEVELS IN Zr^{90}. B.Hartmann and T.Wieldling.

Ark. Fys., Vol. 16, Paper 27, 285-91 (1959).

The angular correlation of the 142 keV–1.14 MeV gamma cascade in Zr^{90} has been measured. The observed distribution function is

$$W(\theta) = 1 - (0.063 \pm 0.008)P_4(\cos\theta).$$

A detailed discussion is given of the experimental results. It is shown that 5, 6, and 8 are the most probable spins of the 2.33, 3.47 and 3.61 MeV levels.

539.14 : 539.2 : 538.27

5654 DYNAMIC ORIENTATION OF NUCLEI BY FORBIDDEN TRANSITIONS IN PARAMAGNETIC RESONANCE.

C.D.Jeffries.

Phys. Rev., Vol. 117, No. 4, 1056-69 (Feb. 15, 1960).

Principally from the viewpoint of orienting radionuclei, this paper considers magnetically dilute paramagnetic ions in crystals for various cases in which there is a non-negligible radio-frequency transition probability for inducing a simultaneous flipping of an electron spin and a nuclear spin. These transitions, forbidden in zero order in high magnetic fields, may be provided by hyperfine interactions, and allow for direct dynamic nuclear orientation by applied r.f. fields. The transition probabilities are calculated for a general anisotropic spin Hamiltonian; thermal relaxation transitions are qualitatively discussed. The resulting steady-state dynamic nuclear polarization and alignment are calculated for the equalization of populations of pairs of levels by sufficient applied r.f. fields. The influence of various relaxation transitions is considered and it is noted that the nuclear orientation available through the forbidden transitions is considerably less sensitive to competing relaxation transitions than that obtained by saturation of the allowed transitions The general predictions are found to be in qualitative agreement with the results of Abraham and Kedzie using radionuclei. The possibilities for dynamic alignment of radionuclei of diamagnetic atoms by forbidden transitions due to weak nuclear-electron dipolar coupling are also briefly discussed.

539.14 : 539.2 : 538.27

5655 DYNAMIC NUCLEAR ORIENTATION OF Co^{60}. M.Abraham, C.D.Jeffries and R.W.Kedzie.

Phys. Rev., Vol. 117, No. 4, 1070-4 (Feb. 15, 1960).

For previous work, see Abstr. 6454 (1957). An experiment to orient Co^{60} nuclei dynamically is described, using a method discussed in the preceding abstract; the orientation is detected by the

γ-ray anisotropy. The Co^{60} is contained as Co^{3+} ions in magnetically isotropic sites of a single crystal of $La_2Mg_3(NO_3)_{12}\cdot 24D_2O$ at 1.5°K and in a field of ~ 1500 G. Application of an r.f. field at a frequency $\nu \sim 9400$ Mc/s produces an orientation when the forbidden h.f.s. transitions $W_2(M, m \rightarrow M \pm 1, m \mp 1)$ are induced; m and M are the magnetic quantum numbers of the Co^{60} nucleus and the Co^{3+} ion, respectively. With a few milliwatts of microwave cavity power a steady-state dynamic nuclear orientation is reached in a time less than a few seconds yielding an anisotropy $\epsilon \sim 1\%$, smaller by a factor 2.7 than the theoretical optimum value. No γ-ray anisotropy is observed when the allowed h.f.s. transitions $W_1(M, m \rightarrow M \pm 1, m)$ are induced. Also, no γ-ray anisotropy is found upon inducing either W_1 or W_2 for Co^{3+} located in the magnetically anisotropic sites in the crystal. All the above observations are in general agreement with the theoretical expectations. An anomalous orientation of Co^{60} is observed when the allowed h.f.s. transitions of abundant stable Co^{59} in the same crystal are strongly induced. This is explicable in terms of a mutual spin-flip process between the two systems.

539.14

5656 DETERMINATION OF THE NUCLEAR MAGNETIC MOMENT OF Hg^{199} FROM THE HYPERFINE STRUCTURE OF THE Hg I LINE AT 5461 A. I.I.Agarbiceanu, N.Ionesco-Pallas, V.Drăganesco, N.Comaniciu and V.Tatu.
C.R. Acad. Sci. (Paris), Vol. 250, No. 2, 317-18 (Jan. 11, 1960).
In French.

The value of the nuclear magnetic moment given in a previous article (Abstr. 109 of 1958) is critized on experimental grounds. The moment has been recalculated from fresh measurements based on experimental improvements, and is 0.504 n.m. G.H.C.Freeman

539.14

5657 NUCLEAR MAGNETIC MOMENTS FROM HYPERFINE STRUCTURE DATA. N.J.Ionesco-Pallas.
Phys. Rev., Vol. 117, No. 2, 505-10 (Jan. 15, 1960).

The nuclear magnetic moments determined from the hyperfine structure of the $^2S_{1/2}$ and $^2P_{1/2}$ states are systematically smaller than those determined by methods of magnetic resonance. The Breit–Crawford–Schawlow correction, which takes into account the finite dimensions of the nucleus, together with the Bohr–Weisskopf correction which takes into account the spatial distribution of nuclear magnetism, succeed in explaining at least the order of magnitude in the preceding difference. However, in the two corrections, certain factors are determined graphically, while others are to a certain extent erroneous, owing to incomplete solving of the Darwin–Gordon differential system. All these difficulties are removed in the present paper and the final result is a completely analytical expression for the total correction. The numerical calculations made for Hg^{199} starting from the ground state $^2S_{1/2}$ (Hg II) are in good agreement with the value of the nuclear moment determined by magnetic resonance.

539.14

5658 HARD CORE CORRELATIONS AND NUCLEAR MOMENTS. J.S.Bell and J.M.Soper.
Nuclear Phys., Vol. 13, No. 1, 167-76 (Oct. [1], 1959).

The influence of hard-core correlations, introduced in the manner of Jastrow (Abstr. 6762 of 1955) on several shell-model matrix elements has been considered. The corrections are all found to be very small, and in a number of cases identically zero.

539.14

5659 NUCLEAR SPIN RELAXATION AND NUCLEAR ELECTRIC DIPOLE MOMENTS. E.M.Purcell.
Phys. Rev., Vol. 117, No. 3, 828-31 (Feb. 1, 1960).

Proposals that nuclear spin relaxation in an appropriate system could serve as a test for the existence of a nuclear electric dipole moment are examined with attention to the consequences of the fact that the electric field at the nucleus is proportional to the nuclear acceleration. It is found that low-frequency fluctuations of the local electric field are suppressed. In particular, the necessarily negative correlation of the momentum transferred in consecutive collisions of an atom in a gas alters the spectral density of the perturbation, from that of uncorrelated pulses, by the factor $\omega^2\tau_c^2/(1+\omega^2\tau_c^2)$, where τ_c is the mean time between collisions. It follows that fairly low gas density is preferable to high. At optimum density a light gas at room temperature carrying electric dipole moments of magnitude $ex10^{-14}$ cm should have a spin relaxation time, in the absence of competing processes, of around 10 minutes. A formula is given for the electrically induced spin relaxation rate in a crystal. The process is hopelessly slow. In the electric coupling of the lattice vibrations to the spin the ordinarily dominant "two-phonon" or "Raman" process is absent, because of the linearity of the connection between local electric field and nuclear motion.

539.14

5660 ON THE EXISTENCE OF OCTUPOLE VIBRATIONS IN NUCLEI. A.M.Lane and E.D.Pendlebury.
Nuclear Phys., Vol. 15, No. 1, 39-55 (Feb. [1], 1960).

It is shown that several different kinds of experimental data point to the existence of octupole vibrations in nuclei. These occur at an excitation energy of about 2.5 to 3 MeV in most nuclei, and rather higher in the light nuclei. Some detailed theoretical interpretation is made of (1) the observed E3 lifetimes, which are interpreted in terms of sum-rules, and (2) the constancy of the octupole excitation energy which is in marked contrast to the well-known peaking in the quadrupole energy near closed shells. Attention is drawn to several kinds of experiment that may give useful further evidence.

539.14

5661 RESONANT ABSORPTION WITHOUT NUCLEAR RECOIL OF THE 23.8 keV γ-RAY FROM Sn^{119}. R.Barloutaud, E.Cotton, J.L.Picou and J.Quidort.
C.R. Acad. Sci. (Paris), Vol. 250, No. 2, 319-21 (Jan. 11, 1960).
In French.

Describes measurements made of resonant absorption without recoil of the 23.8 keV γ-ray of Sn^{119}. Thin sources were prepared by slow neutron activation of enriched Sn^{118} and the absorption deduced from transmission measurements through "thick" targets of natural tin or enriched Sn^{119}. Relative motion of the source and absorber at velocities from 0 to 1 mm sec^{-1} was possible and the temperature of both source and absorber maintained at 77°K, 300°K or 360°K. Results are given for the relative absorption at these temperatures with source and absorber fixed and also for the absorption as a function of relative velocity between source and absorber at 77°K. From these measurements the width of the 23.8 keV γ-ray is calculated to be $(2.5 \pm 0.8) \times 10^{-9}$ eV.

R.H.Thomas

539.14

5662 PAIRING ENERGY EFFECTS IN EXCITED NUCLEI. D.W.Lang and K.J.Le Couteur.
Nuclear Phys., Vol. 14, No. 1, 21-32 (Dec. [1], 1959).

The nucleus is considered as a Fermi gas with pairs of degenerate single-particle states and a coupling energy Δ between the two states of a pair. A statistical treatment gives expressions for the density of excited states and the expected value of the total angular momentum. Suitable approximations for purposes of calculation are indicated. All the formulae become equivalent to those of a simple Fermi gas at high enough excitations.

539.14

5663 OBSERVATIONS ON THE MÖSSBAUER EFFECT IN Fe^{57}. S.S.Hanna, J. Heberle, C.Littlejohn, G.J.Perlow, R.S.Preston and D.H.Vincent.
Phys. Rev. Letters, Vol. 4, No. 1, 28-9 (Jan. 1, 1960).

Mössbauer resonant absorption of the 14 keV γ-ray from the first excited state of Fe^{57} was measured at room temperature and at liquid nitrogen temperature using combinations of sources and absorbers either in the metallic form or in the form of thin layers of $FeSO_4.7H_2O$. The results show that the Mössbauer absorption is greatest for a metal foil and metal absorber, but that appreciable absorption also occurs using the non-metallic samples, and that this is greatly enchanced at low temperatures. For a metallic source and absorber at room temperature the transmission of the absorber was measured as a function of source velocity. Uniform source velocities as low as 10 microns/sec were obtained by mounting it on the carriage of a lathe. The transmission dips were about twice the natural line-width (4.5×10^{-9} eV) and showed an area variation with foil thickness characteristic of a "thick" absorber. An estimate of 0.6 was obtained for the fraction of nuclei emitting or absorbing without recoil at room temperature, and the absorption cross-section at resonance was found to be approximately 1.4×10^6 barns.

R.E.Meads

539.14

5664 EXCITED STATES OF ^9Be FROM THE $^7Li(d,n)^9Be$ REACTION. R.H.Spear
Austral. J. Phys., Vol. 11, No. 4, 502-6 (Dec., 1958).

The energy spectrum of neutrons from this reaction at 700 keV bombarding energy has been studied with nuclear emulsions at 0, 75 and 135°. Both resolution and statistics compare favourably with those of previous nuclear emulsion measurements of this spectrum. The results do not confirm the suggestions made by earlier workers that levels at 2.2, 4.1, 5.3 and 7.5 MeV in Be^9 participate in the reaction, and support the view that the only excited state below 9 MeV in Be^9 is the well-known broad level at 2.9 MeV.

539.14

5665 NOTE ON THE SPIN EXCITED STATES OF CADMIUM-110. M.Sakai, H.Ohmura and T.Momota.
J. Phys. Soc. Japan, Vol. 14, No. 2, 229 (Feb., 1959).

In a previous paper (Abstr. 8550 of 1959) the γ-ray correlations in Cd^{110} were discussed on the assumption that the long lived isomer of Ag^{110} was 5^- or 4^+. The spin of this state has recently been shown to be 6, and so the data is reanalysed and revised spin assignments are obtained for levels in Cd^{110}. L.L.Green

539.14 : 539.17

5666 INTRASHELL-INTERACTION LEVELS AND THEIR EXCITATION BY MULTICHARGED IONS.
V.I.Goldansky and M.V.Kazarnovsky.
Nuclear Phys., Vol. 13, No. 1, 117-24 (Oct. [1], 1959).

On the basis of the shell model one may anticipate the existence of the whole series of hitherto unknown nuclear levels arising from the interaction of nucleons in a given shell. Many of these levels possess angular momenta which strongly differ from those of the ground state, although their energy above the ground state is quite low. The most efficient method of excitation of such levels would seem to be by bombardment of nuclei with multicharged ions. The theory of excitation of low-lying levels by inelastic scattering of complex nuclei is considered. New cases of nuclear isomerism may be produced by low-energy E2 transitions between intrashell-interaction levels.

539.14

5667 NUCLEAR LEVELS OF Cs^{133}.
M.G.Stewart and D.C.Lu.
Phys. Rev., Vol. 117, No. 4, 1044-51 (Feb. 15, 1960).

The gamma rays of Ce^{133} following the electron-capture decay of Ba^{133} were studied using a coincidence scintillation spectrometer. Gamma rays with the following energies (in keV) were observed: 386, 356, 301, 276, (220), 162, 82, 80, and 54. The energies (in keV) of the nuclear levels of Cs^{133} with their spins and parities are: ground state ($\frac{7}{2}$+), 82 ($\frac{5}{2}$+), 162 ($\frac{3}{2}$+), 383 ($\frac{3}{2}$+), and 438 ($\frac{1}{2}$+). The electron-capture transitions and the relative intensities are as follows: (a) to the 438 keV leve, 76%; (b) to the 383 keV level, 11%; (c) to the 162 keV level, 13%. In the decay of Xe^{133}, (1.5 ± 1.0)% of the beta transitions was observed to go to the 162 keV level in Cs^{133} and the remaining go to the 82 keV level.

539.14

5668 INFLUENCE OF *l* FORBIDDENNESS ON THE 82 keV TRANSITION IN Cs^{133}. F.M.Glikeman and M.G.Stewart.
Phys. Rev., Vol. 117, No. 4, 1052-5 (Feb. 15, 1960).

The gamma–gamma directional correlation of the 356-82 keV cascade in Cs^{133} was measured. The directional correlation coefficients were $A_2/A_0 = 0.031 \pm 0.006$ and $A_4/A_0 = -0.006 \pm 0.010$. This is consistent with a spin assignment $\frac{1}{2}(Q)\frac{5}{2}(D+Q)\frac{7}{2}$. The ratio of the the E2 to M1 matrix elements for the 82 keV transition is $\delta = -0.139 \pm 0.007$. The M1 transition is retarded by a factor of ~ 700 and the E2 transition is enhanced by a factor of ~ 20, compared to single-particle transitions. The retardation of the M1 transition is consistent with the assignment $d\frac{5}{2}$ for the 82 keV state and $g\frac{7}{2}$ for the ground state which would make the M1 transition *l* forbidden. The enhancement of the E2 transition indicates there is a cooperative phenomenon present.

539.14

5669 1.12 MeV LEVEL IN ^{19}F.
K.W.Allen, D.Eccleshall and M.J.L.Yates.
Proc. Phys. Soc., Vol. 74, Pt 5, 660-2 (Nov., 1959).

The 1.12 MeV level in F^{19} is shown to decay through the 0.93 MeV excited state, and the lifetime for the 190 keV transition from the 1.12 MeV level is $0.190 \pm 0.045 \times 10^{-6}$ sec. L.L.Green

539.14 : 539.17

5670 A SEARCH FOR LEVELS OF ^7Li BETWEEN 9.0 AND 9.55 MeV EXCITATION. K.H.Purser.
Austral. J. Phys., Vol. 12, No. 3, 231-6 (Sept., 1959).

The cross-section of the reaction $Li^6(n,H^3)He^4$ has been measured, with good energy resolution, over the neutron range 2.0-2.65 MeV. This corresponds to an excitation of Li^7 from 9.0 to 9.55 MeV, a region in which photodisintegration experiments indicate the presence of one or more levels. No resonance structure was observed in this experiment and possible reasons for this are discussed.

539.14 : 539.17

5671 LOW-LYING LEVELS IN P^{30}.
S.S.Yamamoto and F.E.Steigert.
Phys. Rev., Vol. 117, No. 2, 535-7 (Jan. 15, 1960).

The reaction $Al^{27}(\alpha,n)P^{30}$ was studied at 8.15 MeV bombarding energy using nuclear emulsions as detectors. Neutron groups corresponding to Q values of -2.70, -2.96, -3.59, -4.43, and -4.96 MeV were observed. Comparison of the resulting energy level structure in P^{30} with that obtained by other reactions suggests the possible inversion of the two isobaric spin ground states.

539.14 : 539.17

F^{19}, S^{32}, $A^{36,38}$ AND $Ca^{40,42}$ LEVELS. See Abstr. 4098

539.14 : 539.17

LEVEL SCHEME OF Nb^{93}.
See Abstr. 4121

539.14 : 539.16

LEVEL SCHEME OF Pd^{104}. See Abstr. 4055

539.14 : 539.16

LEVEL SCHEME OF Se^{78}. See Abstr. 4065

539.14

5672 A POSSIBLE EXPERIMENTAL METHOD FOR THE PRODUCTION AND DETECTION OF HEAVY HYPER-FRAGMENTS. R.Levisetti and W.E.Slater.
Nuovo Cimento, Vol. 14, No. 4, 895-7 (Nov. 16, 1959).

The detection of heavy hyperfragments requires a production process in which a large amount of energy is imparted to a heavy nuclear fragment. It is suggested that K^- induced fission would be a suitable process. One such fission was observed in a stack of uranium loaded G5 emulsion exposed to an enriched beam of K^- mesons. Scattering measurements were made on the track of the incident particle to confirm that it was a K^- meson.
A.Ashmore

RADIOACTIVITY . NUCLEAR DECAY

539.16

5673 ELECTRONIC SIMULATOR FOR RADIOACTIVE PHENOMENA STUDY. M.Gutmann and R.Comte.
J. Phys. Radium, Vol. 18, Suppl. No. 12, 158A-162A (Dec., 1957).
In French.

The apparatus simulates the evolution with time of a number of atoms and radiation intensity of each member of a radioactive family. Only the case when the periods of the substances are different in the ratio of 100 at the most are considered. Phenomena are registered with a cathode ray oscillograph. The apparatus is suitable for natural and artificial radioactive families and for nuclear reactor poisoning.

539.16

5674 MEASUREMENT OF THE ABSOLUTE ACTIVITY OF NUCLIDES DECAYING BY ELECTRON CAPTURE.
D.H.Vincent.
Nukleonik, Vol. 1, No. 9, 332-6 (Dec., 1959). In German.

Describes a method of measurement of the emission rate of K-quanta in nuclides which decay by electron capture.
S.J.St-Lorant

539.16 : 539.1.07

5675 SCINTILLATION SPECTROMETER FOR COINCIDENCE WORK ON α β AND γ RAYS.
R.Foucher, L.Dick, N.Perrin and H.Vartapetian.
J. Phys. Radium, Vol. 18, Suppl. No. 3, 54A-57A (March, 1957).
In French.

The characteristics of a scintillation spectrometer are given and discussed. This article deals only with energy discrimination paths.

539.16 : 539.1.07

5676 ON THE ADAPTATION OF AN INTERMEDIATE-IMAGE β-SPECTROMETER TO PAIR SPECTROSCOPY.

J.Kjellman and B.Johansson.
Ark. Fys., Vol. 14, Paper 2, 17-29 (1958).

An iron-jacketed intermediate-image β-spectrometer has been adapted for high energy γ-ray measurement from cyclotron-induced reactions. The technique used is the statistical-separation pair detection technique. The apparatus has been tested and calibrated with help of the 6.065 ± 0.009 MeV pair emitting state in O^{16}. A method of using the spectrometer for measuring short half-lives of excited states is described. The natural phase-bunching of the cyclotron is then used as an indicator of the time when a state is born.

539.16 : 539.1.07

5677 TECHNIQUE FOR MEASURING β RADIATION LONGITUDINAL POLARIZATION AND γ RADIATION CIRCULAR POLARIZATION. A.Fasana.

Energia nucleare, Vol. 7, No. 1, 1-10 (Jan., 1960). In Italian.

A survey of the most recent developments of β and γ rays polarization detection techniques. The different effects which depend on the polarization and which may therefore be used in polarization analyses are briefly mentioned. An example of its application is given for each.

539.16

5678 AN APPARATUS FOR RADIATION-CHEMICAL INVESTIGATIONS USING A Co^{60} GAMMA-RAY SOURCE EQUIVALENT TO 280g OF RADIUM.

A.K.Breger, V.A.Belynsky and S.D.Prokudin.
J. nuclear Energy, Vol. 4, No. 4, 504-10 (April, 1957). English translation of article in: Atomaya Energiya, Vol. 1, No. 4, 131 (1956).

A description is given of an apparatus incorporating a standard Co^{60} source equivalent to 280g of radium, for use in radiation-chemical investigations. The assembly is designed on the basis of a critical study of the equipment described in the literature, bearing in mind the requirements of modern radiation-chemical experiments. Various physical and chemical measurements can be carried out during the process of irradiation without endangering the personnel involved. The dose rate is 120r sec^{-1} for irradiation of objects with a volume of 20-30 cm^3, and 30r sec^{-1} for volumes up to 800 cm^3.

539.16

5679 CRITICAL DISCUSSION OF METHODS FOR THE ESTIMATION OF RADIOACTIVE CONTAMINATION BASED ON MEASUREMENTS OF THE TOTAL ACTIVITY.

G.Herrmann, H.Hauser and H.J.Riedel.
Nukleonik, Vol. 1, No. 8, 305-14 (Oct., 1959). In German.

A consideration of the composition of the mixtures of fission products from nuclear weapon tests shows that the measurement of total activity of rainwater and drinking water tends to lead to an overestimate of the activity content. The arguments are illustrated with the results of estimations of Sr^{89}, Sr^{90}, Ba^{140} and I^{131} in rainwater and snow, extended over a period of one year. It is concluded that 85% of the Sr^{90} found would seem to originate in the stratosphere. The fallout of this Sr^{90} is a function of the time of the year, with a maximum in the summer months. S.J.St-Lorant

539.16

5680 ELECTROLYTIC PURIFICATION OF CARRIER FREE TELLURIUM TRACER. A.S.Ghosh Mazumdar.

Proc. Indian Acad. Sci. A, Vol. 48, No. 2, 106-10 (Aug., 1958).

Carrier-free tellurium tracer usually contains iron impurity. Electrolytic purification gives a deposit which shows the activity of only Te^{129}. C.Hilsum

539.16

5681 CONDENSATION PROCESSES FOR THE EXTRACTION OF RADIOACTIVITY FROM AIR. Rama.

Nature (London), Vol. 184, 1789 (Dec. 5, 1959).

Experiments are described on a new technique for the measurement of low-level radioactivity in air samples. Aerosols of size down to 0.01 μ were removed by mixing air samples with steam in a chamber and producing condensation on the fine particles. The dry-air was then removed from the chamber and passed through a filter. Activity of the condensate and filter paper could then be measured. The method is shown to efficient for particle sizes down 0.01 μ and even smaller aerosols are removed; the resistance to air flow is negligible, enabling large gas volumes to be sampled. R.H.Thomas

539.16

5682 GROWTH OF THE TRITIUM CONTENT OF ATMOSPHERIC MOLECULAR HYDROGEN.

K.F.Bishop and B.T.Taylor.
Nature (London), Vol. 185, 26-7 (Jan. 2, 1960).

Measurements of the tritium activity in atmospheric hydrogen at the end of 1958 and in mid-1959 indicated a significant increase, which, considering the results of other workers as far back as 1948, is seen to be consistent with an 18-month doubling time, the abundance increasing even before the first reported detonation of any "hydrogen device" in 1952. No satisfactory explanation is advanced. A.E.I. Research Laboratory

539.16 : 523.5

5683 A NEW METHOD OF POTASSIUM-ARGON ACTIVITY AGE DETERMINATION, AND ITS APPLICATION TO METEORITES. H.Wänke and H.König.

Z. Naturforsch., Vol. 14a, No. 10, 860-6 (Oct., 1959). In German.

The $K^{39}(n,p)A^{39}$ and the $A^{40}(n,\gamma)A^{41}$ reactions form the basis of the neutron activation method described which facilitates the simultaneous estimation of potassium and argon. The ages of meteorites determined with this method range from 2.78×10^9 to 4.25×10^9 years, in agreement with other results. As a byproduct, the A^{37} activity due to the $Ca^{40}(n,\alpha)A^{37}$ reaction leads to the estimation of the calcium content of the specimens. S.J.St-Lorant

539.16

5684 DURATION OF NUCLEOSYNTHESIS.

G.J.Wasserburg, W.A.Fowler and F.Hoyle.
Phys. Rev. Letters, Vol. 4, No. 3, 112-14 (Feb. 1, 1960).

The paper by Reynolds discussing a determination of the age of the elements (see Abstr.4041 of 1960) is critically discussed. The authors discuss the possibility that nucleosynthesis took place over a considerable period and show that Reynold's data are not capable of determining this period exactly. Reynold's measurement is taken to be the maximum time between the end of nucleosynthesis and the formation of the Richardton meteorite. It is claimed that the different quantities of x_e^{129} detected in the Richardton and Beardsley meteorites could be explained by assuming their formation to be separated by 10^8 years, which is just possible within analytical errors. R.H.Thomas

539.16 : 550.14

A POSSIBLE GEOCHEMICAL APPLICATION OF KRYPTON-85. See Abstr. 4777

539.16 : 551.5

SIZE DISTRIBUTION OF RADIOACTIVITY OF NATURAL RADIOACTIVE DUST. See Abstr. 4819

539.16 : 536.54

5685 CALORIMETRIC MEASUREMENTS ON SOURCES COMPOSED OF THE NATURALLY-OCCURRING RADIOACTIVE ELEMENTS. G.V.Gorshkov and N.S.Shimanskaya.

J. nuclear Energy, Vol. 5, No. 1, 115-23 (1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 5, 86 (1956).

A calorimetric method is described for measuring the activity of preparations of elements from the naturally radioactive series. The relation between milligram-equivalent and millicuries has been determined for equilibrium sources of Th^{228} and Ac. The half-life of Ra and the γ-ray energies of Ra and Ac have been measured calorimetrically.

539.16 : 536.54

5686 A CALORIMETRIC DETERMINATION OF THE HALF-LIFE OF Ac^{227}. N.S.Shimanskaya and E.A. Yashugina.

J. nuclear Energy, Vol. 5, No. 1, 161-2 (1957). English translation of article in : Atomnaya Energiya, Vol. 1, No. 5, 133 (1956).

The value found was 21.2 ± 0.8 years.

539.16

5687 LIQUID SCINTILLATION COUNTING OF AQUEOUS SOLUTIONS OF CARBON-14 AND TRITIUM.

J.Shapira and W.H.Perkins.
Science, Vol. 131, 414-15 (Feb. 12, 1960).

A method is reported whereby aqueous solutions containing

weak beta emitters are dispersed as stable emulsions in liquid scintillator counting solutions. This permits the routine counting, with about 10% efficiency, of large numbers of samples containing tritium. Self-absorption does not present a problem when less than 5% aqueous phase is present.

539.16 : 539.14

5688 THE MEASUREMENT OF SHORT LIFETIMES BY A REFINEMENT OF THE RECOIL TECHNIQUE. THE LIFETIME OF THE FIRST EXCITED STATE OF Ra^{224}.
J.C.Severiens and F.W.Richter.
Nuclear Phys., Vol. 13, No. 2, 239-57 (Oct. (2), 1959).

It is shown that, by using a simple electron microscope lens to magnify the distance a nuclear recoil travels in the excited state, it is feasible to measure the time down to 2.0×10^{-11} sec in strongly converted transitions from states populated in alpha-disintegration. The de-exciting conversion electrons are counted only if they are coming from recoils having a velocity selected by using a delayed coincidence technique. Further developments are discussed which may bring the limits down into the 10^{-12} sec range. The method has been tested on the first excited state of Ra^{224} populated in the Th^{228} alpha-decay. The lifetime found was $(6.0 \pm 1.6) \times 10^{-10}$ sec, in agreement with other reported measurements.

539.16 : 539.18

5689 A STUDY OF SOME PROMETHIUM AND SAMARIUM ISOTOPES VERY DEFICIENT IN NEUTRONS.
I.Gratot, M.Le Pape, J.Olkowsky and G.Ranc.
Nuclear Phys., Vol. 13, No. 2, 302-9 (Oct. (2), 1959). In French.

Pm^{141}, Pm^{143} Sm^{142}, Sm^{143} were obtained from several reactions. The mass of Pm^{141} was measured with the isotope separator. The masses of Sm^{142} and Sm^{143} were determined from excitation functions (α,xn). The half-lives were re-determined. Gamma-spectra yield the ratios of K-electron capture to positron emission.

539.16

5690 DIRECT DETERMINATION OF THE HALF-LIVES OF NINE NUCLIDES. J.P.Cali and L.F.Lowe.
Nucleonics, Vol. 17, No. 10, 86, 88 (Oct., 1959).

Values obtained after extensive radiochemical purification were: S^{35}, 88.8 ± 1.0 d; Ca^{45}, 167 ± 3 d; Ru^{103}, 39.4 ± 0.4 d; Ag^{110m}, 262 ± 5 d; In^{114m}, 50.1 ± 0.3 d; Sb^{124}, 60.1 ± 0.3 d; Pm^{147}, 2.7 ± 0.1 yr; Hf^{181}, 45.5 ± 0.3 d; Hg^{203}, 47.2 ± 0.7 d. R.D.Smith

539.16

5691 THE MEASUREMENT OF LOW α AND β ACTIVITY IN WATER. A.Dannecker, H.Kiefer and R.Maushart.
Nukleonik, Vol. 1, No. 8, 319-24 (Oct., 1959). In German.

A co-precipitation and adsorption method is described which facilitates the measurement of radioactive contamination down to $< 10^{-9}$ $\mu c/cm^3$ with reasonable accuracy. The calibration procedure using fallout, uranium spallation products and a number of different isotopes is indicated. S.J.St-Lorant

539.16

5692 BETA–ALPHA ANGULAR CORRELATIONS IN B^8 AND Li^8. M.E.Nordberg, B.Povh and C.A.Barnes.
Phys. Rev. Letters, Vol. 4, No. 1, 23-5 (Jan. 1, 1960).

β–α angular correlations in the β-decay of the two members Li^8 and B^8 of the isotopic spin triplet (Li^8, Be^8, B^8) to the α-unstable third member Be^8 have been measured. Li^8 was obtained by bombarding thin Li targets with 0.75 MeV deuterons, and B^8 by bombarding enriched Li^8 targets with 3.15 MeV He^3 ions. Target irradiation times of 0.4 sec were followed by counting times also of 0.4 sec. β particles were detected in a 3 in. deep plastic phosphor which could be rotated about the target axis with respect to a fixed silicon barrier-layer α counter. The results suggest that the ratio of $(I_{180°}/I_{90°})$ for Li^8 to the same quantity for B^8 is 1.02 ± 0.04. Assuming that the nearly isotropic β–α correlation for Li^8 reported by Hanna et al. (Abstr. 8576 of 1954) is correct, the result disagrees with the prediction of Bernstein and Lewis (Abstr. 1742 of 1959) of 1.15 or 0.85 for the above ratio. This prediction was based on the conserved vector current theory of β-decay and on the use of a value 0.15 Weisskopf units for the probable M1 γ-ray width for the decay of the J = 2⁺, T = 1 Be^8 state to the J =2⁺, T = 0 state.
R.E.Meads

539.16

5693 FOUR-FERMION INTERACTIONS WITH SPIN 3/2 NEUTRINOS. C.L.Hammer and R.H.Good, Jr.
Phys. Rev., Vol. 117, No. 3, 889-90 (Feb. 1, 1960).

Beta decay involving a spin $\frac{3}{2}$ neutrino in weak competition with the spin $\frac{1}{2}$ neutrino has been investigated. This process could explain the deviations from allowed shapes in the Gamow–Teller interactions recently reported by Langer et al. (Abstr. 3862-3 of 1959), but it would then be in disagreement with μ-decay observations.

539.16

5694 γ_5 SYMMETRIES AND RELATIVISTIC CORRECTIONS IN BETA DECAY. M.Morita.
Nuclear Phys., Vol. 14, No. 1, 106-16 (Dec. 1 , 1959).

Making the postulate that the four-fermion interaction must be invariant under the mass reversal transformation $\psi \rightarrow \gamma_5\psi$ and $m \rightarrow -m$, for every pair of the four fields simultaneously, the V – A interaction is obtained, where $C_V = -C_A$, $C'_V = -C'_A$ and C_V/C'_V is arbitrary. This invariance property is very useful in finding a similarity between the nth and the (n±1)th forbidden transitions in beta-decay. In particular, corrections due to the relativistic matrix elements are given for the various formulae describing all kinds of the phenomena in the allowed beta-decay. The Coulomb corrections and the finite de Broglie wavelength effect are taken into account simultaneously.

539.16

5695 SEARCH FOR PSEUDOSCALAR INTERACTION IN BETA-DECAY. S.G.Cohen and R.Wiener.
Nuclear Phys., Vol. 15, No. 1, 79-88 (Feb. [1], 1960).

The degrees of longitudinal polarization of high-energy monoenergetic electrons from Pr^{144} and Rh^{106} were compared by measuring the circular polarization of external bremsstrahlung produced by these electrons when stopped in lead. By using conventional β-decay theory the upper limit for $|X| = |C_p \int \beta\gamma_5 / C_A \int \sigma_r|$ of the Pr^{144} $0^- \rightarrow 0^+$ transition was determined to be 0.08. Making special assumptions regarding the pseudoscalar matrix element, this leads to $|C_p/C_A| \leq 20$.

539.16

5696 ON THE ELECTRON COINCIDENCE SPECTRUM IN DOUBLE BETA DECAY. S.P.Rosen.
Proc. Phys. Soc., Vol. 74, Pt 3, 350-62 (Sept., 1959).

Though simple qualitative arguments imply that the electron coincidence spectra for two-neutrino, and for no-neutrino double β-decay are broadly peaked at $\frac{1}{2}E_0$ and infinitely sharply peaked at E_0 respectively (E_0 is the energy release), a recent calculation has shown that in some circumstances the two-neutrino case spectrum may also be broadly peaked in the region of E_0. A simple model, in which only one state of the intermediate nucleus gives a non-zero contribution to the matrix element, is used to recalculate these spectra. Two extreme approximations are considered: the energy of the intermediate state is equal to, or much greater than, that of the initial state. In both cases, the qualitative result is confirmed, and the recent calculation mentioned above is regarded as incorrect. The model is applied to the double β-decays of Zr^{96} and Ca^{48}. The relation between the conservation of lepton "charge" and the shape of the spectrum is also considered in some detail.

539.16

5697 THE DECAY OF ARSENIC 80.
R.E.Meads and J.E.G.McIldowie.
Proc. Phys. Soc., Vol. 74, Pt 6, 693-8 (Dec., 1959).

Arsenic 80 has been produced by the $Se^{80}(n,p)As^{80}$ reaction induced by 14 MeV neutron irradiation of natural Se and enriched Se^{80} samples. The β^- decay to Se^{80} ($t_{1/2}$ = 15.3 sec) has been investigated by scintillation spectrometry using β–γ and γ–γ coincidence techniques. The γ-ray spectra are interpreted in terms of levels in Se^{80} at 0.66, 1.44, 1.52, 1.77, 1.88, 2.30, 2.50 and 3.01 MeV. The β-trasitions to the ground and first excited state of Se^{80} (log ft values 5.8 and 5.9 respectively) are probably allowed, giving spin 1^+ for the ground state of As^{80}. The $As^{80} \rightarrow Se^{80}$ decay scheme is given.

539.16

5698 THE DECAY OF ^{144}Ce.
N.J.Freeman.
Proc. Phys. Soc., Vol. 74, Pt 4, 449-56 (Oct. 1, 1959).

The beta, gamma and internal-conversion electron spectra of Ce^{144} have been studied with a magnetic spectrometer, scintillation counter and coincidence techniques. The internal-conversion coefficients of the 80 keV and 133 keV γ-rays were measured. Four partial beta-spectra were observed and new evidence has been found for a level at 186 keV in the Pr^{144} nucleus. No evidence was found for the 95 keV and 145 keV γ-rays in the decay.

539.16

5699 RADIATION FROM Ga^{64}.
T.H.Jacobi, H.A.Howe and J.R.Richardson.
Phys. Rev., Vol. 117, No. 4, 1086-90 (Feb. 15, 1960).

The β^+ decay of Ga^{64} and the subsequent gamma spectrum from the de-excitation of Zn^{64} were studied. The β^+ transition to the ground state of Zn^{64} has an end point energy of 6.05 ± 0.03 MeV with log ft = 6.6 and another β^+ group or groups has an end point energy of 2.79 ± 0.08 MeV with a log ft = 4.6. No β^+ transition to the first excited state of Zn(2+) was observed and it was shown that the log ft corresponding to this transition is greater than 7.7. The gamma rays that were observed (0.80, 0.99, 1.25, 1.38, 1.56, 1.78, 1.95, 2.18, 2.34, 2.99, and 3.32 MeV) indicate excited states at 0.99(2+), 1.78(2+), and 3.32(1+) MeV. The positron results indicate that the ground state of Ga^{64} has spin and parity 0+.

539.16

5700 THE β-DECAY OF ^{239}Np.
R.D.Connor and I.L.Fairweather.
Proc. Phys. Soc., Vol. 74, Pt 2, 161-9 (Aug., 1959).

The β-spectrum of Np^{239} has been examined using a prolate spheroidal magnetic spectrometer of resolution 2% and transmission 5%, and partial spectra observed having the following end-point energies and intensities: 713 keV (6.5%), 654 keV (4%), 437 keV (48%), 393 keV (13.5%), 332 keV (28%). The half-life is found to be 2.34 ± 0.02 days and the total disintegration energy Q_β = 724 ± 3 keV. The observations confirm the level scheme $Np^{239} \rightarrow Pu^{239}$ proposed by Hollander (Abstr. 5592 of 1957), and the possibility of a β-transition of end-point energy less than 100 keV as proposed by Baranov and Shlyagin is examined. The $\log_{10}$ft values of the partial spectra and the nature of the γ-transitions are discussed in the light of the asymptotic selection rules.

539.16

5701 THE NUCLEAR MATRIX ELEMENT RATIO IN THE $0^- \rightarrow 0^+$ BETA TRANSITION OF Pr^{144}. J.M.Pearson.
Canad. J. Phys., Vol. 38, No. 1, 148-9 (Jan., 1960).

In the V-A theory, the spectrum shape for this transition is determined by the ratio of two nuclear matrix elements. The size and sign of this ratio, over which there has been disagreement, are discussed briefly. R.J.N.Phillips

539.16

5702 β-DECAY OF RaE.
B.V.Geshkenbein, S.A.Nemirovskaya and A.P.Rudik.
Nuclear Phys., Vol. 13, No. 1, 60-73 (Oct.(1),1959).

Effects due to nonconservation of parity in β-decay of RaE have been considered. Expressions for longitudinal polarization of β-electrons of RaE and angular distribution of β-electrons from an oriented nucleus are obtained, taking into consideration the possibility of time parity nonconservation.

539.16

5703 DETERMINATION OF THE BETA RAY ENERGY SPECTRUM FROM THE ABSORPTION CURVES OF BETA RAYS. N.K.Saha and K.L.Kaila.
Indian J. Phys., Vol. 32, No. 9, 418-29 (Sept., 1958).

An attempt is made to calculate the energy-distribution of the β-ray spectrum of RaE starting from the observed absorption curve of these β-rays. The absorption law of homogeneous β-rays, required as the basis of this calculation, is obtained here by a rigorous curve-fitting of the existing data. Further, Katz and Penfold's remarkable range–energy relation for β-rays is utilized, which seems to avoid most of the limitations of the earlier relations. Improved results are obtained but some divergence with the results of magnetic spectrography remains. Possible causes of the divergence are discussed.

539.16

5704 POLARIZATION OF ELECTRONS IN BETA DECAY OF THALLIUM-204. D.Beaglehole.
Phys. Rev., Vol. 117, No. 4, 1091 (Feb. 15, 1960).

The longitudinal polarization of electrons from the beta decay of Tl^{204} was measured by the Møller scattering method, giving a fairly strong indication of negative polarization.

539.16

5705 BETA–GAMMA DIRECTIONAL CORRELATION IN THE DECAY OF Eu^{152}.
H.Dulaney, Jr, C.H.Braden and L.D.Wyly.
Phys. Rev., Vol. 31, No. 4, 1092-4 (Feb. 15, 1960).

The directional correlation between the 1459 keV beta group and the 345 keV gamma ray of Eu^{152} was measured as a function of beta energy above 600 keV. The experimental results show good agreement, at high energies, with the theoretical correlation for a first forbidden beta transition with $\Delta J = 1$. The influence of the relative size of the matrix elements on the shape of the beta spectrum is discussed.

539.16

5706 POLARIZATION OF CONVERSION ELECTRONS FOLLOWING BETA DECAY. H.R.Lewis and J.R.Albers.
Z. Phys., Vol. 158, No. 2, 155-71 (1960).

Formulae are given for the polarization of conversion electrons in pure and mixed processes following an allowed or forbidden β-decay. Some numerical coefficients are evaluated for the allowed case and K- and L-conversions in terms of the multipolarity of the conversion process. A.E.I. Research Laboratory

539.16

5707 RECENT EXPERIMENTAL RESULTS ON ORBITAL ELECTRON CAPTURE. B.L.Robinson and R.W.Fink.
Rev. mod. Phys., Vol. 32, No. 1, 117-28 (Jan., 1960).

A summary is presented of experimental techniques and experimental results on electron-capture ratios, comparative half-lives, and transition energies. The effect of electron capture from the M shell and higher shells is taken into account. Transition energies are computed from the observed capture ratios for about twenty cases. A summary of mean L-fluorescence yields following nuclear excitation is brought up to date, and the origins of uncertainties in the interpretation of experimental results are discussed. Six experiments are precise enough to be compared critically with the theory of Brysk and Rose (Abstr. 1738 of 1959) and the observed L/K capture ratios are found to be some ten percent greater than predicted. The discrepancies seem to be more or less independent of atomic number for $18 \leq Z \leq 53$; it is not at all clear that the effect of correlations between the coordinates of the K electrons, suggested by Odiot and Daudel (Abstr. 3932 of 1956), is sufficient to account for the discrepancy.

539.16

5708 ANOMALOUS ELECTRIC DIPOLE CONVERSION COEFFICIENTS IN ODD-MASS ISOTOPES OF THE HEAVY ELEMENTS.
F.Asaro, F.S.Stephens, J.M.Hollander and I.Perlman.
Phys. Rev., Vol. 117, No. 2, 492-505 (Jan. 15, 1960).

A detailed review is given of experimental data on the anomalous L- and M-shell conversion coefficients of low-energy electric dipole transitions observed in the decays of odd-A nuclei of high atomic number. The data are consistent in every case with the interpretation that the E1 conversion coefficients in the L_{III} shell agree with the theoretical, model-independent coefficients calculated by Sliv and Band and by Rose. It is definitely established in several well-measured cases that the L_I and L_{III} coefficients are substantially larger than the theoretical values. The most striking anomaly occurs in the 84.2 keV transition in Pa^{231}, where the L_I and L_{III} coefficients are 21 and 15 times larger than the theoretical values, respectively. The experimental L_I and L_{II} coefficients are correlated with the lifetimes of the transitions, and it is shown that the magnitude of the anomaly (L_I plus L_{III}) is proportional to the retardation in gamma-ray lifetime over that calculated from the single-proton formulae. No systematic trend has been observed in the deviations of the L_I and L_{III} coefficients individually.

539.16

5709 RELATIVE INTENSITIES OF K-LL AUGER LINES IN $_{64}Gd^{156}$. G.T.Ewan and J.S.Merritt.
Canad. J. Phys., Vol. 38, No. 2, 324-7 (Feb., 1960).

K-LL Auger electrons from Gd^{156} were observed in a study of the low energy conversion lines from the decay of Eu^{156}, using a $\pi\sqrt{2}$ β-spectrometer set at 0.1% resolution. The measured relative intensities are very similar to those from Sm^{152} previously studied, and since Auger line intensities vary slowly with Z, it is unlikely that either set of results is being affected by mistaking an unreported weak conversion line for an Auger line. Neither set of results agrees with theoretical predictions. A.E.I. Research Laboratory

539.16

5710 CONTINUOUS ELECTRON SPECTRUM ACCOMPANYING K CAPTURE. H.Daniel, G.Schupp and E.N.Jensen.
Phys. Rev., Vol. 117, No. 3, 823-7 (Feb. 1, 1960).

The continuous electron spectrum accompanying K capture was

observed, in the case of Cs^{131}, in three different ways: by measuring coincidences between one K X-ray and an electron, by measuring coincidences between two K X-rays and an electron, and by measuring the single electron spectrum. Furthermore, coincidences between two K X-rays were measured. The coincidence data were taken with scintillation counters while the single electron spectrum was taken with a magnetic spectrometer. The electron spectrum, including the absolute intensity, and the probability for a double hole in the K shell are both found to be in agreement with the theory of Primakoff and Porter (Abstr. 3559 of 1953).

539.16

5711 THE SPECTRA OF LOW ENERGY ELECTRONS FROM THORON AND RADON ACTIVE DEPOSITS. I. ENERGIES AND INTENSITIES OF AUGER L ELECTRON LINES. J.S.Dionisio.

J. Rech. Cent. Nat. Rech. Sci., No. 48, 231-75 (Sept., 1959). In French.

A discussion of the low energy Auger electrons emitted by radon and thoron active deposits is presented. The energies and intensities of the Auger electrons are compared with theoretical and empirical values and various groups attributed to components of the active deposits. L.L.Green

539.16

5712 CONTRIBUTIONS TO THE DECAY OF Tb^{160} TO Dy^{160}. G.Bäckström, J.Lindskog, O.Bergman, E.Bashandy and A.Bäcklin.

Ark. Fys., Vol. 15, Paper 9, 121-9 (1959).

The spectra of conversion electrons and photoelectrons have been re-investigated with high resolution and accuracy. Four new transitions have been found. Their intensities are given as well as their multipolarities. Coincidence measurements have been carried out between the difference beta branches and the most prominent conversion lines. It was possible to decide between two different decay schemes that have been proposed earlier. The possible existence of an odd parity vibrational band (K = 0) is discussed.

539.16

5713 NUCLEAR STRUCTURE EFFECTS IN Tl^{208}. B.I.Deutch and N.Goldberg.

Phys. Rev., Vol. 117, No. 3, 818-22 (Feb 1, 1960).

Angular correlation measurements have been made on the 404 and 279 keV transitions following electron capture from 52 hr Pb^{208}. The following directional correlations were measured: gamma–gamma, K conversion electron–gamma, and gamma–K conversion electron. The angular distribution of all measurements were of the form $W(\theta) = 1 + AP_2(\cos\theta)$. The following results were obtained. For the 404γ–279 Ke^- correlation, $A = -0.052 \pm 0.015$, for the 279γ–404 Ke^- correlation, $A = -0.036 \pm 0.010$, and for the 404γ–279γ correlation, $A = -0.151 \pm 0.010$. No effects due to perturbations of the intermediate state were found. Using the well measured 279 keV K-conversion coefficient, the 404 keV K-conversion coefficient was determined to be 0.117 ± 0.015 while the 680 keV K-conversion coefficient was determined to be 0.011 ± 0.004. From the gamma-gamma angular correlation measurement result and the mixture ratio in the 279 keV transition determined by Stelson and McGowan, the mixture ratio in the 404 keV transition was determined to be $\delta_1 = +0.043 \pm 0.010$. The Sliv value for the K-conversion coefficient for this mixture ratio is 0.147. The correlations involving conversion electrons rule out a $\frac{1}{2} \rightarrow \frac{1}{2} \rightarrow \frac{1}{2}$ transition. They indicate that the M1 particle parameter in the 404 keV transition is about twice the theoretical prediction. The particle parameters for the 279 keV transition also do not agree with the theoretical predictions.

539.16

5714 ELECTRON CAPTURE DECAY OF Tm^{168} AND Tm^{169}. K.P.Jacob, J.W.Mihelich, B.Harmatz and T.H.Handley.

Phys. Rev., Vol. 117, No. 4, 1102-111 (Feb. 15, 1960).

The electron capture of Tm^{168} (87 days) to levels in Er^{168} was investigated with permanent magnet spectrographs and coincidence scintillation spectrometers. The following levels in Er^{168} have been established: 79.8(2+), 264.3(4+), 548.9(6+), 822.4(2+), 897.0(3+), 996.2(4+), 1095.1(3– and $T_{1/2} = 1.2 \times 10^{-7}$ sec), and 1543.1(3)–) keV. The internal conversion data for Tm^{168} (7.7 hr) suggest levels in Er^{168} at 80.6(2+), 265.1(4+), 545.3(6+), 787.1(2+). 860.6(3+), and 957.2(4+) keV, with many more high lying levels. Energy level schemes are proposed for both Er^{168} and Er^{169}. The levels at 822, 897, and 996 keV in Er^{168} and 787, 861, and 957 keV in Er^{166} may possibly be associated with electric quadrupole (gamma) vibrations. Some general features regarding these vibrational levels are discussed and compared with available data on other even–even nuclei in the rare earth region.

539.16

5715 POLARIZATION OF γ-QUANTA IN THE INTERNAL COMPTON EFFECT. F.Yanoukh.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 180-3 (Jan., 1960). In Russian.

Circular polarization of γ-quanta in the internal Compton effect (bremsstrahlung of internal conversion electrons) is considered. Angular correlation between the direction of an outgoing β-electron and that of a circularly polarized γ-quantum is presented both for magnetic and electric type transitions.

539.16

5716 THE INTERNAL CONVERSION COEFFICIENTS OF Br^{80m} (4.4 hr). W.D.Schmidt-Ott, K.W.Hoffmann, I.Y.Krause and A.Flammersfeld.

Z. Phys., Vol. 158, No. 2, 242-50 (1960). In German.

The intensities of the 37 and 49 keV γ-rays of Br^{80m} have been measured with the aid of NaI scintillation spectrometers and compared with the intensity of the conversion electrons registered by an anthracene split crystal spectrometer. It was possible to separate the 49 keV γ-radiation from the intense 37 keV line by selective absorption with balanced Sm and Gd filters. The internal conversion coefficients $\alpha(49\,\text{keV}) = 298 \pm 30$ and $\alpha(37\,\text{keV}) = 1.59 \pm 0.10$ are in good agreement with the calculated values for M3- and E1-transitions. The half-life was measured yielding a value of $T_{1/2} = (4.40 \pm 0.05)$ h.

539.16

5717 LIFETIME OF THE 362 keV E1 TRANSITION IN Tb^{159}. F.R.Metzger and W.B.Todd.

Nuclear Phys., Vol. 13, No. 1, 177-80 (Oct. [1], 1959).

Using the Doppler broadening at elevated temperatures, resonance fluorescence from the 362 keV excited state of Tb^{159} has been observed. From the magnitude of the resonance scattering effect, assuming a spin value of $\frac{7}{2}$ for the excited state and a branching ratio Γ_0/Γ of 0.96, a mean life $\tau_\gamma = (2.0 \pm 0.3) \times 10^{-10}$ sec had been determined for the gamma-ray transition to the ground state. Internal conversion measurements confirmed the electric dipole character of the 362 keV transition.

539.16

5718 EFFECT OF COMPRESSION ON THE DECAY RATE OF Tc^{99m} METAL. R.A.Porter and W.G.McMillan.

Phys. Rev., Vol. 117, No. 3, 795-800 (Feb. 1, 1960).

Motivated by Bainbridge's measurement (unpublished), the authors have attempted a theoretical calculation of the change in lifetime of the internal conversion of Tc^{99m} in compressed Tc metal. The Thomas–Fermi statistical potential, corrected for the self-potential of the electron in question, was employed to obtain the initial and final state electronic wave functions for two volumes: the normal uncompressed state, and 10% compression. Because the energy is so low (~ 2 keV), the only contributions to the internal conversion coefficient come from the M and higher shells, and mainly from the 3p and 3d levels. The principal contribution to the change in the internal conversion coefficient comes, however, from the valence electrons, particularly the 4p, 4d and 5s levels. In order to relate compression to pressure, the compressibility of technetium metal was estimated to be 0.27 megabar^{-1}. From this compressibility and the assumption that the internal conversion coefficient is linear in pressure, the authors calculate for the experimental pressure of 0.1 megabar a fractional decrease in lifetime of $(2 \text{ to } 4) \times 10^{-4}$, the quoted variation residing in the uncertainty of the structure of the 4p band. This result agrees with Bainbridge's measurement, $(2.3 \pm 0.5) \times 10^{-4}$, within the accuracy of the calculation.

539.16

5719 A STUDY OF INTERNAL CONVERSION COEFFICIENTS OF TRANSITIONS IN Pb^{200} AND Pb^{202}. R.Stockendal and S.Hultberg.

Ark. Fys., Vol. 15, Paper 3, 33-48 (1959).

Relative intensities of 14 gamma-rays following the decay of Bi^{200} and 11 gamma-rays from the decay of Bi^{202} have been measured by the method of external conversion in uranium. From additional measurements of the internal conversion lines from the same source (or from a source of known relative source strength) the K-conversion coefficients of these gamma transitions have been determined absolutely with an accuracy varying between 10 and 50%. The multipolarity assignments based on these values are in most cases in agreement with those suggested from scintillation spectra and internal conversion-line spectra. Further support of the excited state of 2566.5 keV in Pb^{202} has been found from the detection of the

K- and L-conversion lines of a 2567.8 ± 2.0 keV transition. The K-conversion line of a 2610.0 ± 2.0 keV gamma ray has been detected, suggesting an excited state of this energy.

539.16

5720 ANGULAR CORRELATION BETWEEN NEUTRINO AND GAMMA QUANTUM IN L-CAPTURE. K.Nagy.

Acta phys. Hungar, Vol. 10, No. 2, 199-219 (1959).

The angular correlation between a longitudinally polarized neutrino and a circularly polarized γ-quantum released by an L-capture is determined. For the form of the weak interaction, the linear combination of S, V, T, A, P couplings is supposed. The angular correlation is calculated for arbitrary γ-transitions and for captures forbidden in any order. As a special case, the ν–γ angular correlation by an allowed L-capture is also given.

539.16

5721 ANGULAR CORRELATION MEASUREMENTS ON Xe^{128}. I.Asplund and T.Wiedling.

Ark. Fys., Vol. 16, Paper 20, 219-25 (1959).

The gamma–gamma angular correlation of the two cascaded gamma radiations with energies 0.540 and 0.455 MeV following the negatron decay of I^{128} has been studied. The spin sequence of the Xe^{128} states is shown to be

$$2+ \xrightarrow[M1+E2]{0.540\ MeV} 2+ \xrightarrow[E2]{0.455\ MeV} 0+$$

with 2.4% M1 in the 0.540 MeV transition. There is a weak indication of positrons of an intensity of only 0.002% in the I^{128}–Te^{128} branch.

539.16

5722 E2 TRANSITIONS FROM THE SECOND 2+ LEVEL OF EVEN–EVEN NUCLEI. D.M.Van Patter.

Nuclear Phys., Vol. 14, No. 1, 42-69 (Dec. [1], 1959).

A survey was made of available data for the γ-ray branching of the second 2+ level of over 50 even nuclei with $A > 30$, together with data for the E2–M1 mixing of the $(2' \rightarrow 2)$ cascade tradition. In addition, presently available data for the Coulomb excitation cross-sections for the second 2+ level of some 24 even nuclei were collected. From these data, three ratios of reduced E2 transition probabilities were calculated, and compared with the predictions of various theories. The comparisons indicate that by far the most successful theory for predicting such ratios is the recent asymmetric rotor model of Davydov and Filippov (Abstr. 2700, 2710 and 1722 of 1958). Perhaps the most striking success of this theory is the prediction for the ratio $B(E2; 2' \rightarrow 0)/B(E2; 2 \rightarrow 0)$ as a function of the energy ratio $E_2(2+)/E_1(2+)$. However, there are some experimental results which remain unexplained, particularly for the ratio $B(E2; 2' \rightarrow 2)/B(E2; 2' \rightarrow 0)$.

539.16

5723 HALF-LIVES OF THE NUCLIDES Au^{195}, Pt^{195m}, AND Pt^{197}. M.Bresesti and J.C.Roy.

Canad. J. Chem., Vol. 38, No. 2, 194-8 (Feb., 1960).

These radionuclides were produced by neutron irradiation in the NRX reactor at Chalk River and were radiochemically purified after the irradiation. The decay of the X-rays and γ-radiations from Au^{195} and Pt^{195m} was observed with a NaI:Tl detector, and the β-decay of Pt^{197} was observed with an anthracene detector. The half-lives are: Au^{195} 199 ± 3 days; Pt^{195m} 4.08 ± 0.12 days; Pt^{197} 20.00 ± ± 0.12 hr. The errors quoted are the estimated reliability of the measurement and include the statistical counting error plus an estimated systematic error.

539.16 : 539.17

5724 SOFT GAMMA RAYS FROM Eu^{152} AND Eu^{154} FOLLOWING RESONANCE NEUTRON CAPTURE. J.E.Draper and A.A.Fleischer.

Nuclear Phys., Vol. 13, No. 1, 53-9 (Oct. (1), 1959).

The gamma-ray spectra up to 300 keV from the odd Eu^{152} and Eu^{154} have been measured with a NaI:Tl scintillator following resonance neutron capture in the 0.33, 0.46, 1.06 and 2.46 eV resonances. Absolute intensities are reported for gamma-rays of 95 ± 4 keV from Eu^{152} and 74 ± 4 and 95 ± 4 keV from Eu^{154}. The thermal capture spectrum of Eu was reinvestigated with a lead critical absorber, and the resulting value for the contribution of a prompt ($\sim<$ 100 μsec delay) ≅ 74 keV gamma-ray from Eu^{152} is $\sim<$ 0.5 photons per 100 captures in elemental Eu. This large discrepancy with the results of Skliarevski et al. (1958) using an unpulsed neutron source, might indicate a new delayed transition.

539.17 : 539.16

RESONANCE NEUTRON CAPTURE IN Eu. See Abstr. 5724

539.16

5725 RADIOACTIVE DECAY OF LUTETIUM 173. R.G.Wilson and M.L.Pool.

Phys. Rev., Vol. 117, No. 3, 807-10 (Feb. 1, 1960).

Ytterbium oxide enriched to 92.6% in the 173 mass number was irradiated with 6 MeV protons. An activity with a half-life of 625 ± 50 days was produced and its assignment to Lu^{173} confirmed by the identification of the ytterbium K X-ray, gamma rays corresponding to transitions among the energy levels established in Yb^{173} by Coulomb excitation of the separated isotope, and the activities produced by the similar proton irradiations of the other enriched isotopes of ytterbium. The observed activity of Lu^{173} consists of the L and K X-rays of ytterbium and gamma rays with energies of 79 ± 1, 101 ± 1, 172 ± 2, 273 ± 2, 349 ± 4, ~450, 556 ± 4, and 630 ± 4 keV and two other gamma rays not resolved in the gamma-ray spectrum but observed in gamma–gamma coincidence measurements. These two gamma rays have energies of approximately 179 and 282 keV. Because no positron radiation exists in the activity of Lu^{173}, the mode of decay is solely by electron capture to Yb^{173}. Gamma–gamma coincidence measurements have lead to the assignment of a 633 keV level with a probable spin of $\frac{5}{2}+$ and the confirmation of a 351 keV level are by L capture only. Branching ratios for the electron capture transitions of Lu^{173} to the levels of Yb^{173} and approximate relative probabilities for the transitions in Yb^{173} are given in a proposed energy level scheme for the decay of Lu^{173}. The choice of 9/2- for the groundstate spin of Lu^{173} is the most consistent with the proposed energy level scheme.

539.16

5726 MEAN LIFE OF THE FIRST EXCITED STATE OF Na^{23}. V.K.Rasmussen, F.R.Metzger and C.P.Swann.

Nuclear Phys., Vol. 13, No. 1, 95-103 (Oct. (1), 1959).

The nuclear resonant scattering by sodium of the 440 keV γ-radiation from $Na^{23}(p, p')$ has been investigated. From the self-absorption of the resonance radiation the mean life of the first excited state of Na^{23} is found to be $(1.8^{+0.5}_{-0.3}) \times 10^{-12}$sec. The E2 partial life of this level has previously been measured by Coulomb excitation, and the E2/M1 amplitude ratio δ is then 0.056. The theoretical ratio of 151° to 115° nuclear resonant scattering is either 1.06 or 1.20, depending on whether δ is positive or negative. The experimental ratio is 1.10 ± 0.04 suggesting that δ is positive.

539.16

5727 GAMMA RAYS IN THE DECAY OF ^{141}Nd. E.W.Cybulska and L.Marques.

Nuclear Phys., Vol. 14, No. 1, 117-19 (Dec. [1], 1959).

The gamma-rays in the decay of Nd^{141} were studied with scintillation spectrometers and coincidences. Seven lines were established with energies of 38, 145, 420, 510, 880, 1150 and 1300 keV. Their relative intensities are 100, 1.7, 0.6, 9.7, 1.2, 2.3 and 1.5 respectively. The line of 38 keV is due to K-capture in Nd^{141} and the line of 510 keV is due to annihilation radiation from the positions of Nd^{141}. The remaining five lines are due to levels in Pr^{141}. A decay scheme is proposed.

539.16

5728 ISOMERIC STATES OF Nd^{141} AND Sm^{143}. R.A.James and C.D.Bingham.

Phys. Rev., Vol. 117, No. 3, 810-11 (Feb. 1, 1960).

Two previously unreported nuclear isomers which belong to the series having 81 neutrons and even numbers of protons have been found and studied. These are Nd^{141m} (half-life 63.7 sec, gamma-ray energy 0.76 MeV) and Sm^{143m} (half-life 137 sec, gamma-ray energy 0.68 MeV). The observed properties agree with the assignment of $h_{11/2}$ and $d_{3/2}$ to the upper and lower states, respectively, as predicted by the single particle model.

539.16

5729 GAMMA RAYS FROM THE 7.6 MeV STATE OF O^{15}. E.Möller.

Ark. Fys., Vol. 15, Paper 22, 251-6 (1959).

The O^{15}, produced by proton bombardment of N^{14}, was studied with a scintillation spectrometer. The three modes of de-excitation through intermediate levels have been confirmed by coincidence measurements. The energy values obtained for these levels are 5.16 ± 0.04, 6.15 ± 0.03 and 6.77 ± 0.02 MeV. No asymmetry of the photo-peak of the 2.39 MeV gamma ray, indicating a splitting of the 5.16 MeV level, could be observed.

539.16

5730 γ-RAYS FROM 2^+ STATES IN ^{16}O.
R.E.Meads and J.E.G.McIldowie.
Proc. Phys. Soc., Vol. 75, Pt 2, 257-61 (Feb., 1960).

The 9.84 MeV and 11.51 MeV levels in O^{16} have been excited by the $C^{12}(\alpha,\gamma)O^{16}$ reaction. The ground-state variation widths of these levels have been measured as 0.02 ± 0.01 eV and 0.9 ± 0.2 eV respectively. These values are discussed in terms of the extreme single particle and collective models.

539.16

5731 DECAY OF OXYGEN 20.
G.Scharff-Goldhaber, A.Goodman and M.G.Silbert.
Phys. Rev. Letters, Vol. 4, No. 1, 25-7 (Jan. 1, 1960).

The γ-ray spectrum following bombardment of a 95% enriched O^{18} gas target with 2.66 MeV tritons has been observed using a 3" × 3" NaI(Tl) scintillation counter. The spectrum contained γ-rays of energy 1.63 and 1.06 MeV as well as annihilation quanta. Both these γ-rays decay with a half life ~ 12.5 sec, in agreement with the 11.4 sec half life reported for F^{20}. The 16.3 MeV γ-ray arises from the decay of F^{20} to the first excited state of Ne^{20}. The F^{20} could be produced either by the reaction $O^{18}(t,n)F^{20}$ or as the β decay product of O^{20}. The 1.06 MeV γ corresponds to the fourth excited state of F^{20} excited, presumably, in the β decay of O^{20}. F^{20} without O^{20} could be produced by reaction $F^{19}(d,p)F^{20}$ and the spectrum showed no peak at 1.06 MeV. By careful analysis of the decay curves of the 1.06 and 1.63 MeV γ-rays in the original spectrum, assuming two partly genetically related activities and a half life of 11.2 sec measured for F^{20}, a half life of 13.6 ± 1.0 sec was obtained for O^{20}. The results also yield a value of log ft = 3.77 for the O^{20} decay to the 1.06 MeV level of F^{20}. This indicates a β transition of the Gamow–Teller type and a spin 1^+ for the 1.06 MeV level in F^{20}.
R.E.Meads

539.16

5732 ON THE ABSORPTION COEFFICIENTS AND ENERGY SPECTRA OF GAMMA-RAYS FROM Ra (B + C) UNDER THICK LAYERS OF Pb ABSORBER P.K.Sen Chaudhury.
Indian J. Phys., Vol. 32, No. 9, 430-8 (Sept., 1958).

The absorption coefficients and energy spectra of gamma-rays from 500 mc of Ra in equilibrium were measured under thick layers of Pb (from 18.5 to 27.5 cm) with a sodium iodide (thallium activated) crystal in combination with a linear amplifier and differential energy discriminator. The absorption coefficient measured with an absorber of very small lateral dimensions for the highest energy gamma-rays e.g., 2.494 ± 0.073 MeV emitted by radium was about 8% less than the theoretical value. When a strong and wide beam was used the measured absorption coefficients showed anomalous variations as previously reported. The energy spectra measured under 18.5 cm and 20.5 cm of Pb absorber showed three peaks at about 2.494 ± 0.073, 2.220 ± 0.065 and at 1.776 ± 0.052 MeV and the energy spectra under 23.5 cm showed in addition to these three peaks indications of another peak at 1.469 ± 0.043 MeV.

539.16

5733 DECAY OF Re^{188}.
R.G.Arns, R.D.Riggs and M.L.Wiedenbeck.
Nuclear Phys., Vol. 15, No. 1, 125-33 (Feb. [1], 1960).

The gamma-rays in Os^{188} following beta-decay of 18 hr Re^{188} were studied using coincidence and directional correlation techniques. The results agree with the principal features of the decay scheme proposed by Johns et al (Abstr. 2347 of 1956). Several new, weak transitions were observed and an additional level is proposed at 1.750 MeV. Directional-correlation measurements were made on six cascades. From the directional-correlation measurements, spins 2, 2, 0, 2, 0, 2 are assigned to the levels at 0.155 MeV, 0.633 MeV, 1.086 MeV, 1.461 MeV, 1.765 MeV and 1.941 MeV, respectively. The 0.478 MeV gamma-ray is a dipole–quadrupole mixture with Q ≤ 99%. The 0.828 MeV and 1.308 MeV gamma-rays are pure dipole.

NUCLEAR REACTIONS

539.17

5734 RELATION BETWEEN ANGULAR DISTRIBUTION AND POLARIZATION IN THE OPTICAL MODEL.
L.S.Rodberg.
Nuclear Phys., Vol. 15, No. 1, 72-8 (Feb. [1], 1960).

The relation between the angular dependence of the cross-section and the polarization in elastic scattering is discussed. A formula is derived for estimating the depth of the spin–orbit potential from the observed polarization. Sufficient conditions for the validity of these results are derived. In the course of this discussion, a useful approximate formula is derived which relates the depth of the central potential, the size of the target, and the positions of the minima in the angular distribution.

539.17

5735 TRANSFER NUCLEAR REACTIONS. II.
M.Demeur and A.Gribaumont.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 45, No. 6, 533-45 (1959).
In French.

For Pt I, see Abstr. 11461 (1959). Perturbation theory is applied to the transfer and excitation nuclear reactions. The cross-sections are evaluated by the impact parameter method.

539.17 : 539.14

5736 NEUTRON EVAPORATION AND LEVEL DENSITIES IN EXCITED NUCLEI. K.J.Le Couteur and D.W.Lang.
Nuclear Phys., Vol. 13, No. 1, 32-52 (Oct. [1], 1959).

The theory of a cascade neutron evaporation process is derived in detail in a form suited to the treatment of highly excited nuclei which have a continuous distribution of excitation energies following a primary direct interaction. The results are found to give good agreement with neutron spectra of nuclei following bombardment with 190 MeV protons observed by Gross (1956). Data from medium-energy neutron reactions, thermal-energy neutron resonances, and heavy-ion reaction experiments are compared. Formulae are derived in an appendix for the effect on the level density of a gap in the single particle level spacing at the Fermi level.

539.17

5737 AN APPROXIMATION FOR NUCLEON–NUCLEUS POLARIZATION EFFECTS. K.R.Greider.
Nuclear Phys., Vol. 14, No. 3, 498-505 (Jan. (1), 1960).

A simple, approximate method of incorporating the effects of a nuclear spin–orbit potential in wave-functions was developed. When used with the appropriate optical-model wave-function for the central potential, it permits closed-form solutions for polarizations and cross-sections that are about as simple to obtain as the Born-approximation solutions. Its application is discussed in two types of problems: the elastic scattering of nucleons by nuclei, and the "direct" interaction type of nuclear rearrangement collision. In this latter problem it is found that the elastic scattering of initial and final state particles from the nuclear spin–orbit potential is primarily responsible for the observed polarization effects.

539.17

5738 SCATTERING OF HIGH ENERGY [220 MeV] POLARIZED NUCLEONS BY COMPLEX NUCLEI.
B.A.Robson.
Austral. J. Phys., Vol. 12, No. 3, 248-57 (Sept., 1959).

The elastic scattering by carbon and calcium is studied using a new expression for the polarization. Except at small angles of scattering, substantial agreement is obtained with the results of calculations using a simplified form of the W.K.B. method. Optical method parameters are found which are compared with those obtained by other workers for this energy region.

539.17

5739 THE SCATTERING OF FAST NUCLEONS FROM NUCLEI.
A.K.Kerman, H.McManus and R.M.Thaler.
Ann. Phys. (New York), Vol. 8, No. 4, 551-635 (Dec., 1959).

The formal theory of the scattering of high-energy nucleons by nuclei is developed in terms of the nucleon–nucleon scattering amplitude. The most important approximations necessary to make numerical calculation feasible are then examined. The optical model potential is derived on this basis and compared with the optical model parameters found from experiment. The elastic scattering and polarization of nucleons from light nuclei is predicted and compared with experiment. The effect of nuclear correlations is discussed. The polarization of inelastically scattered nucleons is discussed and predictions compared with experiments. To within the validity of the approximations the experimental data on the scattering of nucleons from nuclei at energies above ~ 100 MeV appears to be consistent with the theory.

539.17

5740 NUCLEON-SURFACE INTERACTION AND THE (p,n) REACTIONS. J.Sawicki and Z.Szymański.
Acta phys. Polon., Vol. 17, No. 1, 21-8 (1958).

The contribution is discussed to the differential cross-section for the (p,n) reaction (as calculated according to the assumption of the direct n-interaction) due to the nucleon-surface interactions of the Bohr–Mottelson type. The effective contribution in the neutron–proton potential due to the proton-core (surface)–neutron coupling and the proton (neutron)–surface selfaction couplings is calculated. These corrections, being of the second order in the B–M coupling constant, appear as a part of the total (p,n) transition operator. The Coulomb effect of the incident proton wave is taken into account. The relative contribution of the correction terms to the differential cross-section for the $Si^{29}(p,n)P^{29}$ angular distribution is small.

539.17

5741 THE REACTION $Al^{27}(p,\gamma)Si^{28}$. P.Marin, J.Movchet and J.Poupaud.
J. Phys. Radium, Vol. 18, No. 12, 693-4 (Dec., 1957). In French.

Describes the redetermination of the positions and widths of the resonances in the effective cross-section of the $Al^{27}(p,\gamma)Si^{28}$ reaction, in the energy range of 1.3 to 2.2 MeV. S.J.St-Lorant

539.17 : 539.14

5742 NUCLEAR INTERACTIONS OF 660 MeV PROTONS AND THE MOMENTUM DISTRIBUTION OF NUCLEONS IN NUCLEI. L.S.Azhgirey, I.K.Vzorov, V.P.Zrelov, M.G.Meshcheryakov, B.S.Neganov, R.M.Ryndin and A.F.Shabudin.
Nuclear Phys., Vol. 13, No. 2, 258-80 (Oct.(2), 1959).

An investigation is carried out of the angular distributions and, by magnetic analysis,of the energy spectra of secondary charged particles (mainly protons with energies $> \sim 60$ MeV) emitted at angles of 7°, 12.2°, 18°, 24° and 30° in reactions of 660 MeV protons with nuclei of Be, C, Cu and U. The cross-sections for emission of such secondary charged particles increase with decrease of the angles. In the order of decreasing energy the various spectral regions of all investigated elements correspond to diffraction scattering of protons on nuclei (in the small-angle region), single quasi-elastic proton–nucleon collisions, π-meson production on bound nucleons and nuclear cascade. The experimental energy spectra for single quasi-elastic proton–nuclear scattering are compared with the spectra computed in the impulse approximation under various assumptions regarding the momentum distributions of the nucleons in the nuclei. The Be and C data are consistent with a Gaussian nucleon momentum distribution falling to 1/e at an energy of approximately 20 MeV. This means that the mean square value of the nucleon momentum in Be and C nuclei corresponds to an energy of $\sim$ 30 MeV.

539.17

5743 THE POLARIZATION OF PROTONS ELASTICALLY SCATTERED FROM OXYGEN AT 8.7 MeV.
M.A.Al-Jeboori, M.S.Bokhari, B.Hird and A.Strzałkowski.
Proc. Phys. Soc., Vol. 74, Pt 6, 705-10 (Dec., 1959).

A polarized proton beam has been obtained by inserting an internal graphite target in the cyclotron and using the polarization properties of the reaction C^{12} (d,p) C^{13}. By scattering this beam from an ice target, the elastic scattering polarization from oxygen was determined at a number of angles. The results show some similarity to the predictions of the optical model but there is evidence of a rapid variation of the polarization with energy.

539.17

5744 RESONANCES FOR PROTON CAPTURE IN MAGNESIUM.
S.L.Andersen, T.Holtebekk, O.Lönsjö and R.Tangen.
Nuclear Phys., Vol. 13, No. 2, 310-16 (Oct. (2), 1959).

The yield of beta-rays and gamma-rays from magnesium targets of natural isotopic composition has been measured in the proton energy range of 490 keV to 1390 keV, with special emphasis on the region 490 keV to 670 keV. Thirteen new resonances are reported. For some resonances the absolute yield of beta-rays per incoming proton is given. Resonance energies and upper limits for the half-widths are given for a number of resonances.

539.17

5745 $p^1-\gamma$ ANGULAR CORRELATION IN THE INELASTIC SCATTERING OF 16.6 MeV PROTONS BY Mg^{24}.
H.Yoshiki.
Phys. Rev., Vol. 117, No. 3, 773-80 (Feb. 1, 1960).

The angular correlation between the inelastically scattered protons leaving the first excited state of Mg^{24} (1.37 MeV, 2+) and its de-excitation gamma rays produced by the bombardment of 16.6 MeV protons on a natural magnesium target was investigated. For $\theta_{p'} = 30^0$, 42.5°, and 70°, the result shows that the correlation functions are represented fairly well by the simple Born approximation calculation, $\sin^2 2(\theta_\gamma - \theta_{p'})$. However, at larger angles, $\theta_{p'} = 95^0$, 120°, and 150°, changes in the shapes of correlation curves are observed, introducing a contribution from a $\sin^2(\theta_\gamma - \theta_{p'})$ term. This fact suggests the existence of exchange effect as well as the distortion effect in the present nuclear reactions.

539.17

5746 THE ELASTIC AND INELASTIC SCATTERING OF PROTONS BY ^{58}Ni. G.W.Greenlees and P.M.Rolph.
Proc. Phys. Soc., Vol. 75, Pt 2, 201-4 (Feb., 1960).

Absolute differential cross-sections are given for the elastic scattering by Ni^{58} of 9.53 MeV, 9.12 MeV, 8.80 MeV, 8.34 MeV and 7.83 MeV protons for an angular range of 15°–156° (centre-of-mass coordinates). The angular distributions show characteristic maxima and minima, the patterns varying slowly with energy as might be expected on the basis of the optical model. The results are in good agreement with earlier measurements on natural Ni except at backward angles, where higher cross-sections are obtained with Ni^{58}. This is attributed to differing compound elastic contributions from the various Ni isotopes. Absolute differential cross-sections are also given for the inelastic scattering of protons at these five energies from the 1.45 MeV level of Ni^{58}. All the inelastic angular distributions show a forward peaking characteristic of a direct interaction mechanism. It is probable that a distorted-wave treatment will be necessary to fit these results.

539.17

5747 CROSS SECTIONS FOR THE PRODUCTION OF Cl, K, Ca, AND Sc ISOTOPES IN THE BOMBARDMENT OF Pb AND U WITH 3.0 BeV PROTONS. G.Friedlander and L.Yaffe.
Phys. Rev., Vol. 117, No. 2, 578-81 (Jan. 15, 1960).

Cross-sections for the formation of some nuclides in the mass number range 38-48 were measured. The maximum of the isobaric yield distributions for the nuclides from the Pb bombardment occurs at the stability line, while that from U is somewhat on the neutron-excess side. Total cross-sections of 4-5 mb per mass number are deduced from the Pb data leading to a revision of the mass-yield curve in this region as proposed by Wolfgang et al. (Abstr.7677 of 1956). The cross-sections from uranium are approximately twice as large as those from Pb. The data are shown to be consistent with a cascade-fission-evaporation mechanism.

539.17

5748 ON THE SCATTERING OF ANTIPROTONS IN NUCLEAR MATTER. A.G.Ekspong.
Ark. Fys., Vol. 16, Paper 11, 129-36 (1959).

A statistical model calculation of the effective scattering cross-section per nucleon in nuclei is presented. Because of the Pauli exclusion principle, the scattering cross-section is reduced to $\sigma_{eff.} = f \cdot \sigma_{sc.}$ ($\sigma_{sc.}$ being the free antiproton–nucleon cross-section). The anisotropic form of the scattering cross-section is taken into account. Formulae are given by which the reduction factor f may be evaluated. At 190 MeV kinetic energy (inside the nucleus) the computed value of the reduction factor is 0.62 for an assumed total cross-section of 150 mb on free nucleons. The experimental situation is discussed.

539.17

5749 DIFFERENTIAL AND TOTAL CROSS SECTIONS OF THE $B^{10}(d,p)B^{11}$ REACTION OF LOW-DEUTERON ENERGIES. G.R.Harrison, G.D.Schmidt and C.D.Curtis.
Phys. Rev., Vol. 117, No. 2, 532-5 (Jan. 15, 1960).

Differential cross-sections were obtained for production of the four highest energy proton groups in the $B^{10}(d,p)B^{11}$ reaction at E_d = 170 to 250 keV and for the highest energy group at 140 keV. A laboratory angular range from 0° to 140° was covered by the scintillation spectrometer technique using a thin CsI(Tl) crystal. Gamow plots of the total cross-sections yield slopes approximately equal to the value anticipated from the Coulomb barrier penetration factor.

539.17

5750 THE ENERGY SPECTRUM OF PROTONS FROM THE ^{7}Be(d,p)^{8}Be REACTION. R.H.Spear.
Austral. J. Phys., Vol. 12, No. 1, 99-102 (March, 1959).

An angular distribution camera was used to analyze the protons

from the reaction $Be^7(d,p)Be^8$. Since this reaction has high Q-values, foils were used to eliminate lower energy protons from contaminant reactions. At three angles of observation the energy of the excited state observed was therefore estimated from that of the protons corresponding to the ground state of Be^8 whose Q-value was calculable. By combining the results of the three angles, a level in Be^9 with an excitation energy of 2.9 MeV was confirmed. S.E.Hunt

539.17

5751 TRITON ANGULAR DISTRIBUTIONS FROM 14.8 MeV DEUTERONS ON C^{13}. S.Mayo and A.I.Hamburger.
Phys. Rev., Vol. 117, No. 3, 832-4 (Feb. 1, 1960).

An elemental carbon target enriched to 66% in C^{13} was bombarded with 14.8 MeV deuterons. Triton groups corresponding to the ground state, 4.43 and 7.65 MeV levels in C^{13} were magnetically analysed and detected with photographic plates or a scintillation counter, at laboratory angles between 3° and 80°. The angular distributions were found to be in good agreement with Butler pick-up theory, for $l = 1$. The values of the cross-sections at the peak of the angular distributions are 24.3, 9.6 and 0.36 mb/sterad, respectively. These values are accurate within ±25%. The relative reduced widths connecting C^{13} with the ground state, 4.43 and 7.65 MeV levels of C^{13} are 1:0.76:0.039. The results are discussed.

539.17

5752 STUDY OF SOME REACTIONS OF 14.8 MeV DEUTERONS WITH THE LITHIUM ISOTOPES.
E.W.Hamburger and J.R.Cameron.
Phys. Rev., Vol. 117, No. 3, 781-95 (Feb. 1, 1960).

Metallic targets of enriched Li^6 and Li^7 were bombarded with 14.8 MeV deuterons. The outgoing particles were magnetically analysed and detected in nuclear emulsions or scintillation counters. Angular distributions for the following reactions were measured: $Li^6(d,p)Li^{7*}$ 4.6 and 7.46 Mev; $Li^7(d,p)Li^{8*}$ 2.28 MeV; $Li^7(d,t)Li^{6*}$ 3.57 MeV; $Li^6(d,d')Li^{6*}$ 2.19 MeV; $Li^6(d,\alpha)He^4$ ground state; $Li^6(d,t)Li^4$ and $Li^6(d,He^3)He^5$. A search was made for other levels produced in these reactions and in the $Li^7(d,d')Li^{7*}$ reaction. No new levels were observed; upper limits on the cross-sections of unobserved levels are given. The results of the (d,p), (d,t), and D, He^3) reactions compared with stripping theory and with the prediction of the shell model. The agreement is, in general, satisfactory. The Li^6(d,t) and Li^6(d,He^3) reactions produce a continuous spectrum of outgoing particles at each angle. The angular distribution of the tritons (or He^3 particles) is strongly peaked forward and can be fitted with Butler curves having $l = 1$, $r_o = 6f$. The spectra are constant. The shape of the spectra can be explained by the Butler formula if the energy dependence of the reduced width is taken into account. The form of this dependence was deduced from the results of the nucleon–helium elastic scattering experiments.

539.17

5753 DISTORTED WAVE EFFECTS IN STRIPPING.
J.A.Kuehner, E.Almqvist and D.A.Bromley.
Phys. Rev. Letters, Vol. 4, No. 3, 132-4 (Feb. 1, 1960).

Measurements of the p–γ angular correlations for the reactions $Si^{28}(d,p)Si^{29}$ (1.28 and 2.03 MeV) were made in the (d,p) reaction plane with the protons detected on the observed peak of the $l_n = 2$ stripping angular distributions. The data were fitted assuming the distorted wave formalism of Huby et al. (Abstr. 1769 of 1959). The results of plane-wave Born approximation are shown for comparison.
J.A.Evans

539.17 : 539.14

ALPHA-GROUP INTENSITIES IN THE $Al^{27}(d,\alpha)Mg^{25}$ REACTION.
See Abstr. 5650

539.17

5754 AN INVESTIGATION OF SOME (^{3}He,d) REACTIONS IN LIGHT NUCLEI AT 5.2 MeV.
P.D.Forsyth, F. de S. Barros, A.A.Jaffe, L.J.Taylor and S.Ramavataram.
Proc. Phys. Soc., Vol. 75. Pt 2, 291-302 (Feb., 1960).

A broad-range magnetic spectrograph has been used to analyse the deuterons emitted from targets of B^{10}, B^{11}, N^{14} and Al^{27} bombarded with 5.2 MeV singly-ionized He^3 particles. The angular distributions of a number of the deuteron groups have been measured and an attempt has been made to fit them with the predictions of stripping theory. The absolute differential cross-sections have been compared with those of the corresponding (d,n) reactions and the published differential cross-sections for some (d,t) and (p,d) reactions have been similarly compared.

539.17

5755 AN INVESTIGATION OF THE PROTONS, DEUTERONS AND TRITONS FROM THE BOMBARDMENT OF ^{9}Be WITH 5.7 MeV ^{3}He. S.Hinds and R.Middleton.
Proc. Phys. Soc., Vol. 74, Pt 2, 196-207 (Aug., 1959).

A thin beryllium target has been bombarded by 5.7 MeV He^3 particles and the charged reaction products analysed with a high-precision broad-range magnetic spectrograph. Angular distributions of nine proton groups, four deuteron groups and a single triton group have been measured. Most angular distributions exhibit strong forward maxima suggesting that the reaction $B^{11}(He^3,p)B^{11}$, $Be^9(He^3,d)B^{10}$, $Be^9(He^3,t)B^9$, at least in part, proceed via a direct process.

539.17

5756 MECHANISMS FOR THE $O^{16}(He^3, He^4)O^{15}$ REACTION. D.A.Bromley, J.A.Kuehner and E.Almqvist.
Nuclear Phys., Vol. 13, No. 1, 1-31 (Oct. [1], 1959).

Excitation curves for the $O^{16}(He^3,\alpha)O^{15}$ and $O^{16}(He^3,p)F^{18}$ reactions show pronounced resonance structure in the He^3 energy range from 2.0 to 3.0 MeV. It has been demonstrated that the energy dependence of the alpha-particle angular distribution coefficients in the region of the strongest resonance structure requires interference between compound states with angular momentum $\frac{1}{2}$ and $\frac{3}{2}$ and like parity at excitations of 10.44 and 10.46 MeV in Ne^{19}. Total and partial widths for both resonances have been extracted from the data; the He^3 partial width of the $\frac{1}{2}$ resonance is 67% of the single-particle limit. In fitting the experimental data it has been necessary to include the energy dependence of the resonance parameters. Alpha-particle angular distributions measured between resonances, in contrast, indicate a direct interaction mechanism for the reaction. A small, relatively constant direct interaction reaction amplitude and a markedly energy-dependent compound system amplitude which is dominant in the vicinity of compound system resonances are suggested by these measurements. An upper limit of 0.8 μb has been established for the He^3 capture cross-section proceeding through the $\frac{1}{2}$ resonance.

539.17

5757 THE ANGULAR DISTRIBUTION OF SOME PROTON GROUPS FROM THE REACTION $^{16}O(^3He, p)^{18}F$.
S.Hinds and R.Middleton.
Proc. Phys. Soc., Vol. 74, Pt 6, 762-7 (Dec., 1959).

The angular distribution of five proton groups from the reaction $O^{16}(He^3, p)F^{18}$ have been measured at incident energies of 5.9 and 9.16 MeV. An attempt has been made to explain the observations by a double stripping process and some tentative spin and parity assignments have been made.

539.17

5758 STUDY OF THE DIRECT (α,NUCLEON) REACTION, INCLUDING POLARIZATION. E.M.Henley.
Nuclear Phys., Vol. 13, No. 2, 317-32 (Oct. (2), 1959).

A theoretical study of the differential cross-section and nucleon polarization of the direct (α,N) reaction at medium to high energies is carried out. An expression for the transition matrix element is derived from the distorted wave description, but only the distortion of the α-particle by the nucleus is taken into account in an illustrative calculation. It is argued that experimental studies of the polarization are useful for gaining insight into the reaction mechanism. This is explicitly demonstrated by including the spin-dependence and first-order size effects of the interaction responsible for a knock-out process. The reaction examined has several advantages over the similar deuteron stripping process, one of which is the considerably higher degree of the nucleon polarization.

539.17

5759 SCATTERING OF 43 MeV α PARTICLES BY NUCLEI. J.L.Yntema, B. Zeidman and B.J.Raz.
Phys. Rev., Vol. 117, No. 3, 801-6 (Feb. 1, 1960).

The differential scattering cross-sections for the elastic scattering of 43 MeV α-particles by Zn, Ag, Rh, and Au are obtained over the angular range from 12° to 55°. The absolute errors in the cross-sections are estimated to be less than 2% over most of the angular range. The group structure in the inelastic spectrum observed with protons and deuterons is also observed with α-particles. In the spectra of Ag, Rh, and Zn, one group near 2.7 MeV was observed. In Al, V, and Ni a number of groups were observed. In Au and Ta no groups could be resolved. Angular distributions were obtained for the 2.5 MeV group in Rh and Ag and the 2.8 MeV group

in Zn. In the case of the 2.8 MeV group in Zn, the angular distribution shows a very marked diffraction pattern. The data were fitted with Butler's theoretical expression modified to eliminate the assumption that the scattering of 43 MeV α-particles by nucleons is isotropic in the centre-of-mass system. It is shown that this assumption can be easily eliminated in the formal treatment. A comparison with the angular distributions obtained for the 1.04 MeV 2^+ level in Zn with both 43 MeV α-particles and 21.6 MeV deuterons indicates that $l = 3$ is the most plausible assignment for the 2.8 MeV group.

539.17 : 539.14

$Al^{27}(\alpha,n)P^{30}$: LOW-LYING LEVELS IN P^{30}.
See Abstr. 5671

539.17

5760 NUCLEAR REACTIONS OF HIGH-ENERGY C^{12}, N^{14}, AND O^{16} WITH CARBON. M.A.Tamers and R.Wolfgang.
Phys. Rev., Vol. 117, No. 3, 812-17 (Feb. 1, 1960).

The reactions of 160 MeV O^{16}, 140 MeV N^{14}, and 120 MeV C^{12} with C^{12} to yield radioactive products was studied and the results compared with those for proton induced reactions giving formally similar compound systems. Excitation functions for products formed at lower energies are similar in the corresponding proton and heavy ion cases, indicating that their formation involved similar low energy, low spin compound nuclei. However, no "tail" due to knock-on processes, and partly to enhanced alpha emission from the distorted high-spin compound nuclei formed by heavy ions. The contribution of various stripping processes to these yields is discussed.

539.17 : 539.14

INTRASHELL LEVEL EXCITATION BY MULTICHARGED IONS. See Abstr. 5666

539.17

5761 ELECTRON EXCITATION OF COLLECTIVE NUCLEAR TRANSITIONS. L.J.Tassie.
Austral. J. Phys., Vol. 11, No. 4, 481-9 (Dec., 1958).

The inelastic scattering of high energy electrons with excitation of collective nuclear transitions is treated using a simple hydrodynamical model in which the collective nuclear motion is assumed to be irrotational and incompressible. The effects of nuclear compressibility are discussed. Using the Born approximation, scattering form factors are calculated for several charge distributions for electric quadrupole transitions, and the sensitivity of the scattering to the form of the nuclear charge distribution is examined.

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5762 DISPERSIVE EFFECTS IN ELASTIC ELECTRON SCATTERING BY COMPLEX NUCLEI. K.Gottfried.
Nuclear Phys., Vol. 15, No. 1, 92-101 (Feb. [1], 1960).

A Z-independent estimate of the validity of the conventional analysis of elastic electron scattering is made with the help of an optical potential. It is concluded that the dispersive corrections are always of order 1/137.

539.17

5763 ELECTRON SCATTERING BY THE QUADRUPOLE CHARGE DISTRIBUTION OF N^{14}. M.K.Pal.
Phys. Rev., Vol. 117, No. 2, 566-72 (Jan. 15, 1960).

Unpublished data of Meyer-Berkhout on the elastic scattering of 420 MeV electrons by N^{14} have been analysed in the first Born approximation. A detailed treatment is given of the effect of the quadrupole charge distribution of the nucleus in causing a filling-up of the diffraction minimum. The intermediate coupling ground-state wavefunction of Visscher and Ferrell with an admixture of the spheroidal type of collective wave-function, suggested by Fallieros and Ferrell, has been used in calculating the quadrupole form factor. Instead of using the Born approximation monopole form factor, the exact monopole scattering curve computed by Ravenhall from phase-shift analysis has been used. The spin-flip type magnetic scattering has also been calculated and found to be extremely small. The experimental data show the importance of the quadrupole charge scattering in the neighbourhood of the diffraction minimum of the monopole scattering. The quadrupole scattering for the intermediate coupling is, however, completely inadequate to explain the observed data. This gives strong evidence for a collective enhancement of the N^{14} quadrupole moment through core deformation. The model of Fallieros and Ferrell, which predicts a total quadrupole moment of 3.07×10^{-26} cm^2 (collective enhancement = 2.01×10^{-26} cm^2), is found to give a fairly good fit with the data.

539.17

5764 THE SCATTERING OF FAST CHARGED PARTICLES. V. MULTIPLE SCATTERING OF FAST ELECTRONS AND POSITRONS IN XENON. K.Phillips and K.R.Allen.
Proc. Phys. Soc., Vol. 74, Pt 3, 257-68 (Sept., 1959).

For previous parts, see Abstr. 8149 (1957). The multiple scattering of fast electrons and positrons within the energy range of 7 to 17 MeV in xenon has been measured using a cloud chamber. A study has been made of the errors involved and also the use of the technique of overlapping intervals. At higher energies the multiple scattering agrees, within the experimental errors, with the theoretical values predicted by Molière but at energies of less than 10 MeV the experimental values tend to be lower. The measured scattering for the mean energy values agree with the predicted values of Molière but are higher than the values given by the theory of Williams (1939-40). There is no significant difference between the multiple scattering of electrons and positrons.

539.17

5765 THE PHOTODISINTEGRATION OF NUCLEI WITH Z BETWEEN 9 AND 30. B.M.Spicer.
Austral. J. Phys., Vol. 11, No. 4, 490-501 (Dec., 1958).

It is pointed out that the Danos–Okamoto effect (splitting of the giant resonance for non-spherical nuclei into two components) should be more readily observable in the region $9 \leq Z \leq 30$ than in the rare earth region where the initial search for the effect has been made. The ratio of the energies of the two components of the split resonance depends on the deformation of the nucleus from spherical shape. Deformations are even larger in this region of atomic number than for the rare earth nuclei, whose intrinsic electric quadrupole moments are large. The predictions of the theory of Danos (Abstr. 6322 of 1958) are shown to be verified experimentally in five cases. Five other cases where the effect should be observable are discussed.

539.17

5766 THE SHAPE OF THE NUCLEAR PHOTO-RESONANCE IN DEFORMED NUCLEI.
B.R.Mottelson and S.G.Nilsson.
Nuclear Phys., Vol. 13, No. 2, 281-91 (Oct. (2), 1959).

The characteristic features of photonuclear resonance spectra of deformed nuclei are discussed on the basis of some simple estimates in which nucleonic wave-functions are employed in the approximate, "asymptotic" form. The likelihood, in different regions of deformed nuclei, of a resolution of the resonance spectrum into two separate peaks is discussed. Finally, in the appendix, a convenient operator method is given for deriving various nuclear matrix elements in the representation based on the "asymptotic" wave-functions.

539.17

5767 NUCLEAR ABSORPTION OF GAMMA RAYS IN Al, Si, P, S AND Ca.
J.Dular, G.Kernel, M.Kregar, M.V.Mihailović, G.Pregl, M.Rosina and Č.Zupančič.
Nuclear Phys., Vol. 14, No. 1, 131-9 (Dec. [1], 1959).

Bremsstrahlung absorption spectra were measured in five elements, using a magnetic Compton spectrometer. By subtracting theoretical atomic absorption cross-sections, the energy dependence of the nuclear absorption cross-sections was obtained. The absolute value of the nuclear absorption cross-section was not accurately determined.

539.17

5768 THE (γ,p) REACTION ON Au^{197}.
E.D.Makhnovskii.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 95-9 (Jan., 1960).
In Russian.

Energy and angular distributions of protons from gold exposed to bremsstrahlung with $E_{\gamma\,max} = 22.5$ MeV were obtained. The results are compared with calculations based on the statistical theory and the direct photoeffect theories.

539.17

5769 THE PHOTONEUTRON CROSS SECTION OF ^{9}Be IN THE INTERMEDIATE ENERGY RANGE.
H.H.Thies, B.M.Spicer and J.E.E.Baglin.
Austral. J. Phys., Vol. 12, No. 1, 21-9 (March, 1959).

Measured in the region from 6.5 to 18 MeV, using filtered bremsstrahlung radiation from an 18 MeV synchrotron. The integrated cross-section is in agreement with an earlier experiment, but increased resolution has shown a more complex shape,

with sharp maxima at 11.25 ± 0.2 and 13.25 ± 0.2 MeV. The significant features of the cross-section are discussed and compared with the level scheme as it is known at present.

539.17

5770 GAMMA RESONANCE SCATTERING ON THE 17.22 MeV LEVEL IN C^{13}. P.Paul and U.Stierlin.
Nuclear Phys., Vol. 13, No. 4, 576-82 (Nov. [2], 1959). In German.

The absolute total cross-section for elastic scattering of 17 MeV lithium gamma-rays on carbon was measured. From this the cross-section for resonant scattering on the 17.22 MeV level of C^{13} was calculated for an E1 and E2 ground-state transition. The result confirms the assignment 1–, T = 1 for this level. A gamma width $\Gamma\gamma$ = (500 ± 180) eV for the ground-state transition is obtained, which is consistent with the results obtained from elastic proton scattering on this level.

539.17

5771 THE (γ,p) REACTION IN CsI WITH THE γ-RAY FROM THE Li(p,γ) 441 keV RESONANCE.
M.Bormann and H.Neuert.
Z. Naturforsch., Vol. 14a, No. 10, 922-3 (Oct., 1959). In German.

Photoproton emission from a CsI:Tl crystal is investigated. The proton energy spectrum is interpreted as a peak at Ep = 5 MeV, corresponding to evaporation protons, and a larger peak at 9 MeV, corresponding to direct emission. J.A.Evans

539.17 : 539.12

5772 $Cu^{65}(\gamma,3n)$ REACTION AND ITS BEARING ON THE USE OF THE $Cu^{63}(\gamma,n)Cu^{62}$ REACTION FOR BREMSSTRAHLUNG MONITORING. M.J.Aitken and N.Middlemas.
Phys. Rev., Vol. 117, No. 4, 1111-12 (Feb. 15, 1960).

The $Cu^{65}(\gamma,3n)$ reaction was measured from threshold to 110 MeV. The integrated cross-section at 110 MeV is 0.037 ± 0.004 MeV barn. The consequent error in bremsstrahlung monitoring through ignoring this contribution varies from 0.9% at 40 MeV to 1.4% at 110 MeV.

539.17

5773 THE POLARIZATION OF THE NUCLEAR RESONANCE FLUORESCENCE IN GERMANIUM 74. O.Zehender.
Z. Phys., Vol. 157, No. 2, 219-31 (1959). In German.

The 596 keV level in Ge^{74} was excited by γ-radiation from a gaseous As^{74}–Ge^{74} source and the degree of polarization of the scattered γ-quanta measured at 99° and 135°. The sign and magnitude of the polarization indicate an E2 transition. It is concluded that the spin–parity assignment of this level is 2^+.

S.J.St-Lorant

539.17

5774 PHOTONEUTRONS FROM K AND Ca. V.Emma, C.Milone and R.Rinzivillo.
Nuovo Cimento, Vol. 14, No. 5, 1149-56 (Dec. 1, 1959).

Photoneutrons from Ca and K irradiated with 31 MeV bremsstrahlung were studied by means of nuclear plates. Neutrons emitted at 90° from Ca and 60°, 90° and 120° from K were recorded. The spectra show that at least ~ 50% of the neutrons above 2 MeV are due to direct process. For Ca and also for K, a second resonance seems to exist about 10 MeV above the threshold. At 31 MeV photoneutron yields for Ca and K (neutron/mole roentgen) at $\theta \sim 90°$ and for $E_n > 2$ MeV are about the same: $(Y_{Ca}/Y_K) \sim 1.1$.

539.17

5775 NEW "BREAK" IN THE $O^{16}(\gamma,n)O^{15}$ REACTION WITH A NEW SYSTEM OF MEASUREMENT. D.Sadeh.
Phys. Rev. Letters, Vol. 4, No. 2, 75-6 (Jan. 15, 1960).

Cylinders of boric acid were bombarded with γ-rays from a 31 MeV betatron and the 2 minute β^+ activity of O^{15} detected by measuring the two annihilation γ-rays in coincidence. A new "break" in the activation curve for the $O^{16}(\gamma,n)O^{15}$ reaction was found at 15.76 ± 0.02 MeV, 110 keV above the threshold. C.J.Batty

539.17

5776 THE ELASTIC AND INELASTIC SCATTERING OF 6 AND 7 MeV γ-RAYS FROM LEAD. S.G.Cohen.
Nuovo Cimento, Vol. 14, No. 5, 931-7 (Dec. 1, 1959).

6 and 7 MeV γ-rays, produced in the $F^{19}(p,\alpha)O^{16}$ reaction at proton energies of 1.5 and 2.9 MeV, respectively, were scattered from lead, and the spectrum of scattered γ-rays measured at a mean scattering angle of 30°, using a sodium iodide scintillator. Elastic scattering was observed, particularly for 7 MeV γ-rays for which the average differential cross-section at the latter energy is about 5×10^{-28} cm²/sr. This elastic scattering is probably associated with resonance absorption of the Doppler broadened primary γ-rays. In addition, inelastic scattering of γ-rays leading to excited states of lead nuclei were observed.

539.17

5777 FAST PHOTONEUTRONS FROM TANTALUM AND GOLD. L.B.Auli, G.C.Reinhardt and W.D.Whitehead.
Nuclear Phys., Vol. 13, No. 2, 292-9 (Oct. (2), 1959).

The photonuclear cross-sections for the production of neutrons with energies greater than the $Si^{28}(n,p)Al^{28}$ threshold have been determined for tantalum and gold from a maximum bremsstrahlung energy of 18 to 65 MeV. The integrated cross-section to 65 MeV is about 800 MeV mb for tantalum and 700 MeV mb for gold. The fast neutron integrated cross-section is compared with total neutron production cross-section at several energies and is about 10% at all energies.

539.17

5778 A NOTE OF THE REACTION $Zn^{64}(\gamma,n)Zn^{63}$. J.P.Roalsvig, R.N.H.Haslam and J.L.Bergsteinsson.
Canad. J. Phys., Vol. 38, No. 2, 320-4 (Feb., 1960).

The activation curve for this reaction was determined from threshold to 23 MeV maximum proton energy, using the University of Saskatchewan 24 MeV betatron together with improved methods of correcting for self-absorption in the copper and zinc samples. The absolute yield value at 22 MeV maximum proton energy, was found to be 1.60×10^8 n/mole 100 r, after correction for K-capture. The cross-section curve has been calculated using the method of Penfold and Leiss. The values of maximum and integrated cross-section obtained are 48 mb and 0.33 MeV-barn respectively. The present results are compared with the higher values obtained by other workers and the differences discussed.

A.E.I. Research Laboratory

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5779 THE IMAGINARY PART OF THE OPTICAL MODEL POTENTIAL FOR NEUTRON INTERACTIONS WITH NUCLEI. G.L.Shaw.
Ann. Phys. (New York), Vol. 8, No. 4, 509-50 (Dec., 1959).

The Brueckner nuclear many-body theory is modified so that it can be applied to the problem of dealing with quasi-stationary states. In this manner one is able to treat low-energy neutron interactions with heavy nuclei taking into account the identity of the incident neutron with the nucleons in the nucleus. An expression for optical model potential is obtained, and the imaginary part W is calculated. The results indicate a surface absorption potential: W, for a given incident neutron energy, has a constant central region and reaches a peak > twice the central value in the surface region. An investigation is made of the next step after the compound state is formed. For heavy nuclei, compound nucleus formation dominates over compound elastic scattering. For light nuclei (A < 50), there may be fluctuations of the cross-section related to two-particle states.

539.17 : 539.19

5780 SLOW-NEUTRON SCATTERING BY ROTATORS. II. H.C.Volkin.
Phys. Rev., Vol. 117, No. 4, 1029-36 (Feb. 15, 1960).

For Pt I, see Abstr. 6006 (1959). The methods developed in Pt I for extending the neutron scattering formalism of Zemach and Glauber to any type of molecular rotator have been employed to derive generalized forms of the differential cross-sections for rotator scattering. A mass-ratio expansion for the treatment of the high-energy limit is illustrated on the classical cross-section and then employed in the treatment of the more general quantuum-mechanical expression for the differential cross-section. The results apply to an arbitrarily asymmetric rotator. The very low-energy approximation is carried out for the symmetric rotator, and the procedure is compared with the explicit summing of the partial cross-sections for individual rotational transitions. The inelastic correction to the static approximation for interference scattering is calculated to an accuracy of first order in the mass ratios for the case of the symmetric rotator.

539.17

5781 SLOW NEUTRON CAPTURE AND THE (d,p) REACTION. C.K.Bockelman.
Nuclear Phys., Vol. 13, No. 2, 205-23 (Oct. (2), 1959).

The suggestion of Lane and Wilkinson that the similarity between

(d,p) and (n,γ) spectra may be understood in terms of the target as a unique parent state is applied in detail. An examination of all the available data shows six nuclei for which the assumption appears to be satisfied, and four ambiguous situations. Clear disagreement is found for three nuclei. In order to inquire further into the circumstances responsible for the cases of agreement, the cross-section for direct neutron capture with the emission of an electric dipole γ-ray is evaluated with the help of the optical model. Comparison with experiment shows that one of the six cases of agreement can be attributed to direct capture. However (d,p) data do not exist in the region where the optical model predicts the largest direct cross-sections. These maxima occur at the same A for which the s-wave strength function is greatest. Measured (n,γ) cross-sections for E1 transitions are in many cases compatible with the direct process.

539.17

5782 RAPID ASSESSMENT OF NEUTRON ACTIVATION. R.B.Mesler.

Nucleonics, Vol. 18, No. 1, 73-5 (Jan., 1960).

Data sheet No. 35. A method based on an approximation of the true build-up curve by its two straight-line asymptotes, and a graphical estimation of the error introduced by the approximation. Mean lives and saturated specific activities are tabulated for 100 nuclides. R.D.Smith

539.17 : 539.16

5783 EVIDENCE FOR SOME NEW ISOMERIC STATES. E.C.Campbell and P.F.Fettweis.

Nuclear Phys., Vol. 13, No. 1, 92-4 (Oct. (1), 1959). In French.

Tabulates a number of (n,γ) reactions together with the half-lives of the products and the decay γ energy. S.J.St-Lorant

539.17

5784 EFFECTIVE CAPTURE CROSS-SECTIONS IN THE FAST REACTOR ZEPHYR. H.Rose.

J. nuclear Energy, Vol. 5, No. 1, 4-15 (1957).

The simple perturbation technique has been used to determine effective capture cross-sections for a large number of materials (including 65 of the natural elements) in the small experimental fast reactor ZEPHYR. Measurements have been made not only with the majority of the natural elements, but also with a considerable number of enriched isotopes. The results provide interesting information concerning the dependence of the fast-neutron capture cross-sections upon nucleon number and shell structure.

539.17

5785 s- AND p-WAVE NEUTRON SPECTROSCOPY. I. PEAK HEIGHT ANALYSIS AND LEVEL ASSIGNMENTS. E.Merzbacher, P.W.Crutchfield, Jr and H.W.Newson.

Ann. Phys. (New York), Vol. 8, No. 2, 194-210 (Oct., 1959).

Methods for analysing transmission measurements of neutron resonances in the keV region are discussed. The "peak height" and the "double difference" methods are described in detail; they are useful in the keV region where the peak cross-section of an isolated resonance, which is almost entirely due to scattering, has a predictable value. In order to illustrate the methods of analysis, the spins and widths of several compound nucleus states in sodium and fluorine are determined from experimental data. The assignments are 1^+ and 3^- for the 3 and 53 keV resonance in sodium, respectively; 2^- and 1^- for the 27 and 49 keV resonances in fluorine; and 2^+ for the 36 keV resonance in aluminium. Some details of the sodium cross-section between 1 and 100 keV are discussed.

539.17

5786 s- AND p-WAVE NEUTRON SPECTROSCOPY. II. EVEN–EVEN NUCLEI.

H.W.Newson, R.C.Block, P.F.Nichols, A.Taylor, A.K.Furr and E.Merzbacher.

Ann. Phys. (New York), Vol. 8, No. 2, 211-22 (Oct., 1959).

Total cross-sections have been measured for Ni^{58}, Ni^{60}, Ce^{140}, Ce^{142}, Mg^{24}, Mg^{25}, Mg^{26}, Si^{28}, Zr^{90}, Zr^{92} and Zr^{94} from 3 to 300 keV. Of the eight well-separated levels found in Ni^{58}, six are matched by levels in Ni^{60} at very nearly the same energies. This effect is very difficult to understand on the basis of conventional nuclear models. Strength functions (Γ_n^0/D) of 3.4×10^{-4}, 2.3×10^{-4}, 1.0×10^{-4}, and 1.2×10^{-4} and average level spacings of 23, 21, 3 and 1 keV have been estimated for Ni^{58}, Ni^{60}, Ce^{140} and Ce^{142}, respectively. The strength functions and level spacings of the Zr isotopes are difficult to interpret because of the importance of both s- and p-wave resonances; however, a preliminary average cross-section analysis of Zr and neighbouring nuclei shows a very definite peak in the p-wave strength function at atomic weight 92. Resonance parameters have been obtained for resonances observed in the magnesium isotopes.

539.17

5787 s- AND p-WAVE NEUTRON SPECTROSCOPY. III. AREA ANALYSIS OF NEUTRON RESONANCES. K.K.Seth.

Ann. Phys. (New York), Vol. 8, No. 2, 223-49 (Oct., 1959).

In the commonly used methods of area analysis of neutron resonances observed in transmission experiments the interference between resonance and potential scattering is either neglected or taken into account only approximately. A method of analysis is developed here which takes into account such interference accurately. It is shown that the importance of the interference effect in obtaining Γ or $g\Gamma_n$ is determined not only by the size of the potential phase shift, but also by the sample thickness. Results of calculations are presented and it is shown that the errors inherent in the conventional methods of analysis due to the neglect of interference effect can become abnormally large in certain cases. Such cases are usual in the keV region of neutron energy and not uncommon in the eV region. In the keV region of neutron energy certain cases also occur in which the conventional area is close to zero and leads to very inaccurate determination of widths. For such cases a new method of area analysis is proposed. Some applications of the new analysis techniques for analysis of individual resonances are presented.

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5788 s- AND p-WAVE NEUTRON SPECTROSCOPY. IV. EXPERIMENTAL METHODS IN THE keV REGION. P.F.Nichols, E.G.Bilpuch and H.W.Newson.

Ann. Phys. (New York), Vol. 8, No. 2, 250-65 (Oct., 1959).

A new high-resolution collimation-detection system has been developed for neutron total cross-section measurements in the keV region. The instrument has a variable opening between conical polyethylene collimating surfaces and admits neutrons emitted from the Li(p,n) Be reaction at about 160° with respect to the direction of the protons. The neutrons are detected by two separate banks of boron trifluoride counters. Neutron energy spread is relatively constant over a wide range of neutron energies. The resolution is apparently limited at present by nonuniformity of the thin Li targets. The optimum resolution obtainable with a reasonable counting rate has been calculated. Measurements have been made of the yield at 160° of the small extraneous background scattered into the detectors by the target backing and other sources. The total cross-section for Bi^{209} has been measured from 10 to 136 keV; prominent s-wave resonances occur at 12, 15, 32, 44.5, 68, 80, 84, 94, 101, 112, 116 and 134 keV in addition to five other less prominent levels and three known resonances below 10 keV. A resolution correction was applied to the first four resonances and the peak cross-sections corrected in this manner are close to the theoretical values. The average level spacing is 10 ± 3 keV per s-wave channel (spin-state). An estimate has been made of the neutron widths Γ_n by a new method (see previous paper). The s-wave strength function based on more than twenty resonances is $(0.56 \pm 0.17) \times 10^{-4}$.

539.17

5789 GAMMA-RAY YIELDS FROM THE RESONANT CAPTURE OF SLOW NEUTRONS. E.R.Rae and E.M.Bowey.

J. nuclear Energy, Vol. 4, No. 2, 179-90 (Feb., 1957).

A scintillation detector is described which is used in a time-of-flight experiment with the 15 MeV linear electron accelerator at Harwell for the measurement of gamma-ray yields from neutron capture. The efficiency and background of the apparatus are discussed. The gamma-ray spectra for the first ten levels in silver are compared, and the variation in detection efficiency from resonance to resonance is examined and shown to be small. On this basis the gamma-ray yield curves for silver are used to compute values of the quantity $\sigma_{\gamma\gamma}\Gamma$ for each of the first ten levels. This quantity is of importance in the evaluation of the fundamental resonance parameters The use of the apparatus with very small samples of material is also described. The high sensitivity is here utilized to obtain yield curves for separated isotopes, and so to assign resonances to the correct isotopes.

539.17

5790 ON THE THERMAL NEUTRON CAPTURE CROSS-SECTIONS. H.S.Hans and M.L.Sehgal.

Indian J. Phys., Vol. 32, No. 6, 276-80 (June, 1958).

Experimental and theoretical values of thermal neutron capture

cross-sections have been compared for a number of cases. An attempt is made to explain the discrepancy in many cases. In the case of Ag^{107}, Ni^{62}, In^{113}, Hg^{200}, Mo^{97}, and Hf^{179}, it is suggested that negative energy levels exist close to zero energy. Radiation width in the case of Co^{59} is considered to be 0.6 eV, instead of 0.2 eV as given by Segre (1953).

539.17

5791 TOTAL NEUTRON CROSS SECTION FOR C^{13} FROM 500 keV TO 1350 keV.

C.M.Huddleston, R.O.Lane, L.L.Lee, Jr and F.P.Mooring.
Phys. Rev., Vol. 117, No. 4, 1055-6 (Feb. 15, 1960).

The total neutron cross-section of C^{13} was measured in an effort to observe resonance corresponding to states recently reported in the $B^{11}(He^3,p)C^{13}$ reactions (Abstr. 8276 of 1958). No resonances were observed within the 5% accuracy of the measurement. Upper limits are set on the possible widths of the states.

539.17

5792 (n, d) REACTIONS WITH 14 MeV NEUTRONS ON ^{27}Al, ^{40}Ca, ^{55}Mn, ^{63}Cu, ^{103}Rh.

L.Colli, F.Cvelbar, S.Micheletti and M.Pignanelli.
Nuovo Cimento, Vol. 14, No. 5, 1120-9 (Dec. 1, 1959).

Energy spectra of the deuterons from these reactions are presented. Deuteron peaks corresponding to the fundamental level as well as to some excited levels of residual nuclei are brought into evidence. In Mn and Rh, the existence of gross-structure is shown.

539.17

5793 MEASUREMENTS OF (n, p), (n, α) AND (n, 2n) TOTAL CROSS SECTIONS AT 14 MeV.

C.S.Khurana and H.S.Hans.
Nuclear Phys., Vol. 13, No. 1, 88-91 (Oct. (1), 1959).

Total cross-sections for the following reactions have been measured at 14 MeV neutron energy:- $Al^{27}(n, p)Mg^{27}$(115 ± 10mb); $Al^{27}(n, \alpha)Na^{24}$(111 ± 9mb); $Sb^{123}(n, 2n)Sb^{122}$(1706 ± 120 mb); $Sb^{121}(n, 2n)Sb^{120}$(453 ± 43mb); $Ag^{109}(n, 2n)Ag^{108}$(619 ± 40mb); $Ag^{109}(n, \alpha)Rh^{106}$(38 ± 6mb); $Sc^{45}(n, 2n)Sc^{44}$(129 ± 9mb); $Sc^{45}(n,\alpha)K^{42}$ (132 ± 8mb); $Ti^{50}(n, p)Sc^{50}$(147 ± 13mb); $Ti^{48}(n, p)Sc^{48}$(97 ± 16mb).

539.17

5794 THE ABSORPTION CROSS-SECTION OF THE HARWELL BORON STANDARD FOR NEUTRONS OF 2200 m/sec.

P.A.Egelstaff.
J. nuclear Energy, Vol. 5, No. 1, 41-9 (1957).

Several measurements of the absorption cross-section of boron for neutrons of 2200 m/sec, using the Harwell slow chopper, are described. The result obtained for the boron in the Harwell boric-acid standard is 771 ± 5 barns. This measurement is compared with other recent determinations and with data obtained from the ratio of boron-to-gold cross-sections. Some inconsistencies in these data are noted. The most probable values of the absorption cross-sections at 2200 m/sec are derived from all the data taken together. These values are: for boron in the Harwell boric-acid standard 769 barns; for gold 98.5 barns.

539.17

5795 BRANCHING RATIO FOR SLOW NEUTRONS. M.Lall Sehgal.
Indian J. Phys., Vol. 31, No. 6, 329-31 (June, 1957).

A study of slow neutron reaction with B^{10} has been made with BF_3 proportional counters. The relative probability of the reactions $B^{10}(n,\alpha)Li^7$ and $B^{10}(n,\alpha)Li^{7*}$ is determined by covering the counter with and without cadmium cap.

539.17

5796 MEASUREMENT OF THERMAL NEUTRON ABSORPTION CROSS SECTION USING SPHERICAL SYMMETRY METHOD. A.M.Ghosh and N.K.Ganguly.
Indian J. Phys., Vol. 31, No. 6, 285-96 (June, 1957).

An experimental arrangement is described and utilized to measure thermal neutron absorption cross-section of Cl using spherical symmetry method, developed by the present authors. From the measured value it is shown that this method can effectively separate the scattering effects and measure the absorption cross-section directly. Different sources of errors are discussed and their effects are estimated.

539.17

5797 MEASUREMENT OF THERMAL NEUTRON ACTIVATION CROSS-SECTION. M.L.Sehgal.
Indian J. Phys., Vol. 31, No. 12, 630-4 (Dec., 1957).

The various errors involved in measuring the activation cross-sections for thermal neutrons are discussed. Error due to "self-protection", is specially considered and a semi-empirical relation is given for its correction. Thermal neutron activation cross-sections for In^{115}, Ag^{107} and Ag^{109} are measured taking into account these corrections. Design of a sigma pile is given.

539.17 : 539.16

5798 INELASTIC NEUTRON SCATTERING IN Mn^{55}. N.Nath, M.A.Rothman, D.M.van Patter and C.E.Mandeville.
Nuclear Phys., Vol. 13, No. 1, 74-87 (Oct. (1), 1959).

Gamma-rays excited by inelastic neutron scattering in Mn^{55} have been studied. Coincidence methods have been used to observe those gamma-rays which cascade through the 127 keV first excited state. Branching ratios have been measured for four levels, as well as the cross-sections for excitation of each level. Theoretical calculations of the cross-section, using a diffuse-edge potential well, give good agreement with the experiment, if appropriate spin values are assigned to each level.

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5799 THE TOTAL NEUTRON CROSS-SECTIONS OF Pd, Os, Ir, Mo, In, I, Ta, Th, AND U^{238} IN THE RESONANCE REGION. I.A.Radkevich, V.V.Vladimirsky and V.V.Sokolovsky.
J. nuclear Energy, Vol. 5, No. 1, 92-107 (1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 5, 55 (1956).

Level parameters are given, calculated from previously published cross-section curves and from new measurements on Ir, Th, and U^{238} described herein. The measurements were made over the range 4.5 - 10 000 eV with a mechanical velocity selector of resolution 0.08 μsec m^{-1}. Curves are plotted showing the distributions of neutron widths.

539.17

5800 THE RADIATIVE CAPTURE CROSS-SECTION OF ^{232}Th FOR NEUTRONS IN THE ENERGY RANGE 300 TO 1200 keV. J.F.Barry, L.P.O'Connor and J.L.Perkin.
Proc. Phys. Soc., Vol. 74, Pt 6, 685-8 (Dec., 1959).

A redetermination of the (n,γ) cross-section of Th^{232} in the energy region 300 to 1200 keV has been made by an activation method. A discrepancy existed between the level structure of this nucleus obtained directly from inelastic-scattering measurements and the level structure deduced by Lane and Lynn (Abstr. 8842 of 1957) in their interpretation of radiative-capture cross-section measurements. The energy dependence of the radiative-capture cross-section used by Lane and Lynn showed a plateau extending between the neutron energies of 250 and 650 keV followed by a sharp drop. The present measurements show that this plateau actually extends up to about 900 keV so that the (n,γ) cross-section is no longer inconsistent with the level structure of Th^{233} deduced from inelastic-scattering measurement.

539.17

5801 INELASTIC SCATTERING OF FISSION NEUTRONS IN URANIUM. R.C.Bhandari and R.D.Jain.
J. nuclear Energy, Vol. 4, No. 3, 326-8 (March, 1957).

Energy distribution of inelastically scattered neutrons in uranium, based on various models of a nucleus, has been considered. An approximate comparison with the neutron spectrum in the fast reactor EBRI shows that nuclear level density calculated on the assumption of a degenerate Fermi–Dirac gas gives the best fit.

539.17

5802 THE THERMAL-NEUTRON ABSORPTION CROSS-SECTION OF U^{233}. T.S.Green, V.G.Small and D.E.Glanville.
J. nuclear Energy, Vol. 4, No. 4, 409-17 (April, 1957).

The ratio of the thermal-neutron absorption cross-sections of U^{233} and gold has been determined using a modification of the "Clinton oscillator". The cross-section of U^{233} was found to be 578 ± 17 barns, compared with gold taken as 98.6 barns.

539.17

5803 THE ACTIVATION CROSS-SECTION OF U^{238}. B.V.Efimov and Y.I.Mityaev.
J. nuclear Energy, Vol. 5, No. 1, 158-9 (1957). English translation of article in : Atomnaya Energiya, Vol. 1, No. 5, 130 (1956).

539.17 : 539.14

2.0-2.65 MeV NEUTRON CROSS-SECTION FOR $Li^6(n,H^3)He^4$.
See Abstr. 5670

539.17

5804 ANGULAR DISTRIBUTION OF FRAGMENTS FROM FISSION OF URANIUM INDUCED BY 185-MeV PROTONS.
U.L.Vallinder and H.Tyrén.
Nuclear Phys., Vol. 15, No. 1, 152-4 (Feb. [1], 1960).

Protons of 185 MeV were used to study the angular distribution of the total fission products from natural uranium. The distribution is found to have an anisotropy of -0.09 ± 0.05.

539.17

5805 THE ISOTOPIC COMPOSITION OF RARE-EARTH ELEMENTS FORMED BY FISSION OF URANIUM, THORIUM, AND BISMUTH WITH 680 MeV PROTONS.
F.I.Pavlotskaya and A.K.Lavrukhina.
J. nuclear Energy, Vol. 5, No. 1, 149-57 (1957). English translation of article in : Atomnaya Energiya, Vol. 1, No. 5, 115 (1956).

Results are given of a radiochemical investigation of the rare earths formed by fission of uranium, thorium, and bismuth nuclei with 680-MeV protons. In this work, which was carried out in 1954, special attention was given to methods of separation of these elements. The influence of various factors on the degree of separation was studied to find the optimum conditions for an ion-exchange chromatographic separation method. These factors were the nature of complexing agents (ammonium acetate, citrate, oxalate, and lactate), the pH of the eluant and the concentration of rare earths. A decay-curve method permitted detection of radioisotopes of almost all the rare earths and determination of yields of some of them. The formation of a new isotope of samarium with half-life approximately 20 days is also proposed.

539.17

5806 NEW "WORLD-AVERAGE" THERMAL CROSS-SECTIONS.
D.J.Hughes.
Nucleanics, Vol. 17, No. 11, 132-3 (Nov., 1959).

The fourth "world consistent set" of absorption and fission cross-sections, the ratio of capture to fission, the average number of neutrons per fission, and the average number of neutrons emitted per neutron absorbed, is tabulated for U^{233}, U^{235} and Pu^{239}. The new values are contrasted with the old, demonstrating that the major remaining inconsistencies are in data for Pu^{239}. R.D.Smith

539.17

5807 THE VARIATION OF α OF $_{92}U^{235}$ WITH ENERGY IN THE INTERMEDIATE-ENERGY RANGE. S.Oleksa.
J. nuclear Energy, Vol. 5, No. 1, 16-32 (1957).

Recent experiments have made possible a new evaluation of resonance parameters for some of the low-energy levels of $_{92}U^{235}$. The data permit a numerical calculation of the variation of α (ratio of radiative capture to fission cross-sections) of $_{92}U^{235}$ with energy in the range 100-10 000 eV in accordance with a method proposed by Wigner. The effects of fitting the experimental data with several different distributions were examined. The results are: (1) The variation of $\alpha(U^{235})$ with energy from 100 eV to 10 000 eV is a slow one, no matter which of several distributions is assumed to hold for the fission and neutron widths; (2) The values of α obtained by means of Wigner's theory are in good agreement with results of the KAPL integral experiments; (3) The calculated values of $\delta(n,f)$ agree reasonably well with the experimental values; (4) the theory can be applied with confidence to fissionable materials other than U^{235} for which comparable information about low-energy resonances is available.

539.17

5808 TWO CASES OF TRIPLE FISSION OF URANIUM-235.
J. Catala, J.Casanova and V.Domingo.
Nature (London), Vol. 184, 1057-8 (Oct. 3, 1959).

Examination of photographic plates loaded with enriched uranium, irradiated in the thermal column of the Belgian reactor BR-1, has shown that, of 350 000 fission events observed, two occurred in which the U^{235} nucleus divided into three fragments, two heavy and one light. It was verified that the processes were not due to ordinary binary fission in which one of the fragments had collided with a nucleus in the emulsion, producing a recoil. The masses of the three fragments, the energy of the lightest one, and the total energy in each of the two events were as follows:

M_1 (a.m.u.)	M_2 (a.m.u.)	M_3 (a.m.u.)	E_3 (MeV)	E_{total} (MeV)
150 ± 13	74 ± 13	12 ± 2	35 ± 7	166 ± 33
169 ± 13	55 ± 13	11 ± 2	40 ± 10	187 ± 36

The results are compared with those of other work in which triple fission has been reported. R.E.Meads

539.17

5809 FISSION PARAMETERS FOR U^{233}.
G.J.Safford and W.W.Havens,Jr.
Nucleonics, Vol. 17, No. 11, 134-8, 205-6 (Nov., 1959).

Reactor calculations require more accurate data for U^{233}. The measurements of total cross-section in UK, USSR and USA are not consistent. The best value (at 0.0253 eV) is considered to be 694.3 ± 1.3 b. The absorption cross-section σ_a is obtained by subtracting the scattering from the total cross-section. σ_s is not well established but the probable value is 15 ± 2 b. The measurements of the variation of σ_a with energy are in good agreement except below about 0.02 eV. The fission cross-section σ_f variation with energy is well established, but there is some scatter in the absolute value at 0.0253 eV. 580 ± 12 b is taken as the best value. A value for η (neutrons emitted per neutron absorbed) of 2.07 ± 0.02 is consistent with all the measured values. The number of neutrons per fission $\nu = 2.43 \pm 0.02$ is consistent with several measurements, but the latest determinations suggest a slightly lower value. Further measurements of σ_f and $1 + \alpha$ (α = ratio of capture to fission) are suggested. R.D.Smith

539.17

5810 DELAYED NEUTRON INVESTIGATIONS WITH THE ZEPHYR FAST REACTOR. I. PNEUMATIC TRANSFER SYSTEM. R.D.Smith, D.D.McVicar and E.A.Thorne.
J. nuclear Energy, Vol. 4, No. 2, 133-41 (Feb., 1957).

A pneumatic transfer system used in delayed neutron experiments is described. The system enabled small samples of fissionable materials to be irradiated near the reactor core for preset times of $\frac{1}{2}$ sec or longer and transferred in less than one second to a remote neutron detector.

539.17

5811 DELAYED NEUTRON INVESTIGATIONS WITH THE ZEPHYR FAST REACTOR. II. THE DELAYED NEUTRONS ARISING FROM FAST FISSION IN U^{238}, U^{232}, U^{233}, Pu^{239}, AND Th^{232}. H.Rose and R.D Smith.
J. nuclear Energy, Vol. 4, No. 2, 141-6 (Feb., 1957).

The yields of five groups of delayed neutrons resulting from fast fission of U^{238}, U^{233}, U^{235}, Pu^{239}, and Th^{232} were investigated and compared with previous results. Some evidence was found that a shortlived precursor contributes to a small extent to the observed twenty-two-second group.

539.17

5812 THE EVAPORATION OF METALS BY FISSION FRAGMENTS. B.V.Ershler and F.S.Lapteva.
J. nuclear Energy, Vol. 4, No. 4, 471-4 (April, 1957). English translation of article in Atomnaya Energiya, Vol. 1, No. 4, 63 (1956).

The number of atoms evaporated from the surface of a metal during the emission of fission fragments or alpha particles from it has been measured, using U^{233} and Pu^{239}. This number is markedly dependent on the presence of a surface layer of oxide; for the emission of fission fragments from U^{233} it increases from 24 to 1200 when the oxide film is removed. For Pu^{239} with an oxide-free surface the number is 3500 atoms per fission fragment. For Pu^{239} undergoing spontaneous decay 0.02 atoms are evaporated for each alpha-particle emitted. An approximate calculation indicates that the number of atoms in the zone heated by passage of a fission fragment to the temperature necessary to cause evaporation is, for uranium, 5.6×10^6. The amount of kinetic energy transferred from the fission fragment to the atoms of the lattice is evidently greater than the value at present accepted in the literature.

NUCLEAR POWER STUDIES

539.17

5813 SUMMARIZED PROCEEDINGS OF A CONFERENCE ON NUCLEAR FUEL CYCLES — LONDON, JANUARY 1959.
W.A.Cooper.
Brit. J. appl. Phys., Vol. 10, No. 6, 237-9 (June, 1959).

The conference was organized by the Institute of Physics in collaboration with the British Nuclear Energy Conference. Full proceedings appeared in the Journal of the British Nuclear Energy Conference, July,1959.

539.17 : 669

METALLURGY IN THE DEVELOPMENT OF ATOMIC POWER.
See Abstr. 4834

539.17

5814 SUBCRITICAL REACTOR AS A COLLEGE FACILITY. F.S.Dietrich.

Amer. J. Phys., Vol. 28, No. 4, 309-14 (April, 1960).

A subcritical assembly of natural uranium and ordinary water has been constructed at Haverford College as an educational instrument. Many of its parameters have been determined; their theoretical calculation and experimental measurements are discussed.

539.17

5815 NUCLEAR REACTORS IN FRANCE. J.Yvon.

J. Phys. Radium, Vol. 18, No. 10, 545-51 (Oct., 1957). In French.

539.17

5816 DRESDEN NUCLEAR POWER STATION.

Nucleonics, Vol. 17, No. 12, chart facing p. 68 (Dec., 1959).

Nucleonics Reactor File No. 8. Details of the Dresden reactor, which is a forced-circulation, dual-cycle boiling light water reactor with an output of 625 MW (H). The core contains 59.5 tons of enriched uranium (1.5% U^{235}) in the form of oxide pellets canned in Zircalloy-2. R.D.Smith

539.17

5817 THE DESCRIBING FUNCTION OF NUCLEAR REACTORS. H.B.Smets.

I.R.E. Trans Nuclear Sci., Vol. NS-6, No. 4, 8-12 (Dec., 1959).

The integro-differential equation of reactor dynamics is studied and approximated. It is found that a reactor can be represented by means of a linear system and a nonlinear system in cascade. The transfer function of the linear system is the classical low-power transfer function. The nonlinear system in a nonlinear amplifier with an exponential characteristic. The describing function is computed in the case of a water-moderated reactor and it is shown that the gain near resonance increases with the magnitude of a reactivity sinusoidal oscillation.

539.17

5818 OMRE OPERATING EXPERIENCE. C.A.Trilling

Nucleonics, Vol. 17, No. 11, 113-17, 234 (Nov., 1959).

The organic moderated reactor OMRE operated for one year with its first core. After clean-up of the coolant and coolant system and the installation of an improved filtering system it is now operating with a second core similar to the first. Data obtained on the decomposition rate of the polyphenyl coolant has confirmed that the radiation stability is adequate for this type of reactor. The decomposition products have been analysed and the high-boiling fraction shown to be a complicated mixture of substituted polyphenyls and triphenylenes in an approximate ratio of 3 to 1. Extensive measurements were made of the changes in physical properties of coolant during operation. The observed decrease in heat-transfer coefficient was small. The activity of the coolant system was due mainly to inorganic impurities. The maintainance of the reactor has proved very simple. R.D.Smith

539.17

5819 OMCR POWER PLANTS: THEIR STATUS AND PROMISE. S.Seigal and R.F.Wilson.

Nucleonics, Vol. 17, No. 11, 118-123,236 (Nov., 1959).

A review of organic liquid moderated and cooled nuclear reactors (OMCR) from technological and economic standpoints. Radiolytic damage rates to polyphenyls at 20-30% concentration of higher molecular weight fractions seem well established, but there are discrepancies in the data at lower concentrations. Heat transfer characteristics are well established and curves for forced convection and nucleate boiling conditions are given together with the measured effects of radiation. Coolant purification systems and improved fuel elements including UO_2 clad in APM (pure Al with 6-8% Al_2O_3 powder) are discussed. Design data are given for Piqua, a 45MW(H) and possible future 100 MW(H) reactors. R.D.Smith

539.17

5820 HTGR — UNDERLYING PRINCIPLES AND DESIGN. P.Fortescue, D.Nicoll, C.Rickard and D.Rose.

Nucleonics, Vol. 18, No. 1, 86-90 (Jan., 1960).

The high-temperature gas-cooled graphite reactor (HTGR) is a helium-cooled thermal reactor using fuel and fertile material in the form of carbide dispersed in graphite. The good thermal conductivity of the mixed moderator and fuel enables power densities up to 15 kW/litre to be achieved. The high coolant outlet temperature (1380° F) enables high thermal efficiences to be obtained using simple heat exchangers. A typical fuel element would have the composition 1 atom U^{235} to 40 Th^{232} and 4000 C^{12}, and will withstand very high burnup of fissile material whilst maintaining good neutron economy. Data for the 40 MW(E) HTGR prototype are given. R.D.Smith

539.17

5821 PHYSICS OF THE BBC–KRUPP HIGH TEMPERATURE REACTOR.

R.Schulten, C.B.v.d.Decken, H.W.Schmidt and H.Wundt.

Nukleonik, Vol. 1, No. 8, 277-86 (Oct., 1959). In German.

The construction of the BBC–Krupp, high temperature, gas cooled, power reactor is described. The following topics are discussed qualitatively: cooling; choice of cooling gas; contamination of the primary cooling circuit; core materials; possibilities of breeding from Th^{232} in the core; feeding and consumption of fuel; short and long term reactor dynamics. (See also following abstract). D.H.Lord

539.17

5822 NEUTRON TEMPERATURE OF A MODERATOR COMPOSED OF SMALL REGIONS AT VARIOUS TEMPERATURES. E.Kern.

Nukleonik, Vol. 1, No. 8, 286-90 (Oct., 1959). In German.

For a moderator composed of small regions at different temperatures and with dimensions less than or equal to the neutron free path, it is possible to define an overall neutron temperature. A normalized addition is made of the various Maxwell energy distributions, corresponding to th se regions, to obtain an overall distribution. By comparing the mean absorption cross-sections obtained from this overall distribution and from a single Maxwell distribution, the overall neutron temperature is deduced. As an illustration this calculation was done for the BBC–Krupp reactor (see preceding abstract). D.H.Lord

539.17

5823 CONTAMINATION AND CLEANUP OF NRU. E.O.Hughes and J.W.Greenwood.

Nucleonics, Vol. 18, No. 1, 76-80 (Jan., 1960).

A fuel rod failure in NRU resulted in burning of the fuel element when attempts were made to remove it from the reactor. The contamination levels inside and outside the building are reported and the cleanup procedures used described. See also following abstract. R.D.Smith

539.17

5824 CHALK RIVER EXPERIENCE WITH FUEL WATERLOGGING.

A.J.Mooradian, G.M.Allison and J.G.Palmer.

Nucleonics, Vol. 18, No. 1, 81-5 (Jan., 1960).

Water accumulation within cladding of reactor fuel elements, coupled with thermal cycling, can lead to bulging and failure of cladding. This was apparently the cause of the NRU failure (see preceding abstract). The mechanism of bursts with metallic fuels is believed to involve formation of uranium hydride and its subsequent rapid decomposition by reaction with water. Oxide fuel elements are more stable but can fail as a result of steam pressure. Delayed neutron monitors on the coolant stream have proved the most sensitive detectors of waterlogged fuel element failures. R.D.Smith

539.17

5825 INVESTIGATIONS ON THE MODERATING PARAMETERS OF "DOWTHERM A" AT DIFFERENT TEMPERATURES. L.Pál, L.Bata and I. Kiss.

Acta phys. Hungar., Vol. 10, No. 2, 173-84 (1959).

Moderating parameters of a medium consisting of 26.81% diphenyl and 73.19% diphenyl oxide were tested at different temperatures. The temperature dependence of the diffusion length is found to obey the empirical relation $L_d = 4.002 \exp(0.0014\ T)$. The slowing down length is $L_s = 11.24 \pm 0.06$ cm, at 36°C. At higher temperatures, the slowing-down length increased considerably, so that the testing tank could not be considered any longer as being of infinite size and therefore only the temperature depedence of the most probable slowing-down length for this tank of finite dimensions could be specifically given.

539.17

5826 GEOMETRIC BUCKLING MEASUREMENTS USING THE PULSED NEUTRON SOURCE METHOD.

N.G.Sjöstrand, J.Mednis and T.Nilsson.

Ark. Fys, Vol. 15, Paper 35, 471-82 (1959).

The geometric buckling of cylindrical reactors with one or both ends rounded has been determined by pulsed source measurements with small polyethylene geometries. The results were in general accord with theoretical calculations. The diffusion parameters of polyethylene were also determined. The diffusion length was 2.12 ± 0.03 cm, and for the capture cross-section of hydrogen a value of 0.337 ± 0.005 barns was found. The effect of control rods was studied using thin cadmium rods in water. Good agreement was found for axial, central rods, whereas the theoretical predictions for the effect of diagonal rods were too high.

539.17

5827 ON A METHOD FOR THE EXPERIMENTAL DETERMINATION OF THE BUCKLING OF A HETEROGENEOUS REACTOR STRUCTURE. A.Ziegler.

Nukleonik, Vol. 1, No. 8, 295-305 (Oct., 1959). In German.

A small region of the structure to be investigated is placed in another reactor. Methods are described to adjust, by enriched fuel elements and light-water layers, the neutron spectrum and flux density distribution in this region to their required values. The buckling of the heterogeneous structure can then be determined by comparison with a homogeneous arrangement using a solution of UO_2SO_4. The experimental techniques (e.g. rotating probes) and theoretical basis for this method are discussed and errors are estimated. D.H.Lord

539.17 : 534.13

FUEL ROD VIBRATION DUE TO PARALLEL FLOW COOLING. See Abstr. 5072

539.17

5828 COOLANT BLOCK DAMAGES SRE FUEL. R.W.Dickinson.

Nucleonics, Vol. 18, No. 1, 107, 109-11 (Jan., 1960).

Tetralin (used to cool a shaft freeze seal on the main primary pump) leaked into the sodium coolant of the sodium reactor experiment SRE. Decomposition products caused partial blockage of core coolant channels resulting in the melting of part of the core. The sequence of events leading to the failure is described. R.D.Smith

539.17

5829 THE REACTIVITY EFFECT DUE TO NEUTRON STREAMING IN AN EMPTY TUBE. E.Critoph and R.M.Pearce.

J. nuclear Energy, Vol. 4, No. 4, 445-59 (April, 1957).

The critical size of a reactor is increased when neutrons can stream along an empty tube passing through the reactor. A perturbation method has been used to calculate the change in reproduction constant required to compensate for streaming in an empty tube parallel to the axis of a right cylindrical reactor. The effect of removing moderator from tubes inserted in ZEEP has been measured for tubes with radii in the range 1 cm to 8 cm. After making minor corrections for effects other than streaming, the experimental results are in satisfactory agreement with the calculations. The reactor constants necessary in making the comparison were obtained from the change in critical size due to a known absorber which was placed at the lattice site in question.

539.17

5830 A VECTOR DIAGRAM FOR REACTOR CHANNEL TEMPERATURES. P.R.J.French.

Nuclear Engng, Vol. 5, 120-2 (March, 1959).

The axial distribution of heat generation in a cylindrical core with vertical coolant channels is approximately sinusoidal. Temperatures can be plotted therefore by means of a simple vector diagram, the construction of which is given.

539.17

5831 SYSTEMS OF HEAT REMOVAL FROM NUCLEAR REACTORS. V.S.Chirkin.

J. nuclear Energy, Vol. 5, No. 1, 124-34 (1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 5, 94 (1956).

Different ways of using power plant and coolant to extract the heat evolved in a reactor core are described. A classification is given of heat extraction systems in which water, boiling water, aqueous solutions, gases, and liquid metals are used as coolant.

539.17

5832 SIMPLE RELATIONS DESCRIBE REACTOR POWER BURSTS.

Nucleonics, Vol. 17, No. 10, 98, 100-1 (Oct., 1959).

Approximate equations giving the peak power, integrated power and duration of the burst are derived from simple assumptions for the initial period and reactivity feedback. Good agreement is obtained with experimental results from Spert, Kewb, Godiva, Bepo and Borax. R.D.Smith

539.17

5833 STATISTICAL ANALYSIS OF POWER-REACTOR NOISE. J.A.Thie.

Nucleonics, Vol. 17, No. 10, 102-111 (Oct., 1959).

Fourier analysis of reactor noise (random fluctuations in the power level of a nuclear reactor) can be used to provide useful information. Resonances in reactor transfer functions, neutron lifetime, the basic cause of noise, and the equations governing the dynamic behaviour of the reactor can be investigated. The method is illustrated by an analysis of EBWR noise. R.D.Smith

539.17

5834 THE SIMULATION OF THE STATIONARY FLUX DISTRIBUTION OF A REACTOR BY THE ANALOGUE COMPUTER. A.Kirchenmayer.

Nukleonik, Vol. 1, No. 8, 290-5 (Oct., 1959). In German.

It is shown how an analogue computer can be used to solve the difference equations which are approximate solutions to the time-dependent multi-group diffusion equations. A method is described for automatically setting into the computer, parameters at values which can give stationary solutions. The accuracy of the method and ways of improving it are discussed. D.H.Lord

539.17 : 541.13

AMP – EFFECTIVE ION EXCHANGER FOR TREATING FISSION WASTE. See Abstr. 4719

539.17

5835 THERMONUCLEAR PROCESSES. R.Bickerton.

Nature (London), Vol. 184, 240-1 (July 25, 1959).

Report on a convention held in London in April 1959 and organised by the Institution of Electrical Engineers in conjunction with the British Nuclear Energy conference.

539.17 : 621.387 : 621.039

5836 THE BASIC PHYSICS OF THERMONUCLEAR PROCESSES. T.E.Allibone and D.R.Chick.

Proc. Instn Elect. Engrs, Paper 2888 [Convention on Thermonuclear Processes], publ. April, 1959 (Vol. 106A, Suppl. No. 2, 3-11, 43-6).

Republication, with discussion, of the paper abstracted in Abstr. 5079 (1959).

539.17 : 537.52 : 621.387 : 621.039

5837 THE DESIGN AND PERFORMANCE OF ZETA. E.P.Butt, R.Carruthers, J.T.D.Mitchell, R.S.Pease, P.C.Thonemann, M.A.Bird, J.Blears and E.R.Hartill.

Proc. Instn Elect. Engrs, Paper 2901 [Convention on Thermonuclear Processes], publ. April, 1959 (Vol. 106A, Suppl. No. 2, 12-29, 43-6).

Republication, with discussion, of the paper abstracted in Abstr. 5084 (1959).

539.17 : 537.52 : 658.57 : 621.039

5838 THE MODIFICATION OF ZETA IN 1958. J.T.D.Mitchell, H.R.Whittle, E.M.Jackson and P.B.Clarke.

Proc. Instn Elect. Engrs, Paper 2930 [Convention on Nuclear Processes], publ. April, 1959 (Vol. 106A, Suppl. No. 2, 74-81, 82-5).

Republication, with discussion, of the paper abstracted as Abstr. 5086 (1959).

539.17 : 621.039.6

5839 SCEPTRE III A. A.A.Ware.

Proc. Instn Elect. Engrs, Paper 2898 [Convention on Thermonuclear Processes], publ. April, 1959 (Vol. 106A, Suppl. No. 2, 30-5, 43-6).

Republication, with discussion, of the paper abstracted in Abstr. 5083 (1959).

539.17 : 537.534 : 621.039

5840 STUDIES OF TRAPPING FAST CHARGED PARTICLES IN A CONSTANT MAGNETIC FIELD. I.N.Golovin.

Proc. Instn Elect. Engrs, Paper 3030 [Convention on Thermonuclear Processes], Vol. 106 A, Suppl. No. 2, 95-9,100 (1959).

Outlines the principles of, and experimentation connected with, O.G.R.A., the molecular ion injection mirror machine at the Atomic Energy Institute, Moscow. Trajectories of the molecular ion beam have been observed and methods of increasing the path-length to

the design figure of 1 km are described. Experimental confirmation of adiabatic trapping has been obtained by measuring the life-times of trapped β-particles produced by the decay of tritium in a small mirror machine. The life-time was measured from the ionization produced, as a function of tritium pressure, mirror ratio and azimuthal symmetry of the magnetic field. The maximum number of mirror reflections observed exceeded 10^7. Non-adiabatic losses were observed, particularly with azimuthal asymmetry present.

R.S.Pease

539.17 : 537.56 : 621.039 : 621.387

PHYSICAL MEASUREMENTS ON HEAVY-CURRENT DISCHARGES. See Abstr. 5304

ATOMS

539.18

5841 ATOMIC TERM SYMBOLS BY GROUP THEORY. R.F.Curl, Jr and J.E.Kilpatrick.

Amer. J. Phys., Vol. 28, No. 4, 357-66 (April, 1960).

The problem of the terms that arise from a given electronic configuration is defined and then solved by elementary methods. The problem is then solved much more easily by the use of elementary group theory. Finally, a new closed solution is given by means of which the terms from even the most complicated electronic configurations may be rapidly enumerated. This new method has been used to compile a table of all terms from configurations up through nf^{14}.

539.18 : 539.12

DIRAC CONTINUUM RADIAL WAVE FUNCTIONS. See Abstr. 5542

539.18

5842 ON THE DIAMAGNETISM OF THE THOMAS–FERMI ION. T.Tietz.

Acta phys. Hungar., Vol. 7, No. 4, 427-31 (1957).

An approximate formula is derived for free positive ions. The accuracy of this formula is proved by comparison of the values calculated from it with the exact numerical values of Fermi. As a further example of the accuracy of this formula, the diamagnetic susceptibility of the Thomas–Fermi ion is calculated as a function of the atomic number and valency of the ion. The experimental results for the susceptibilities of alkali and alkali earth metal ions are in good agreement with the theory.

539.18

5843 THE PHASE SHIFTS FOR THE THOMAS-FERMI POTENTIAL CORRECTED FOR THE SELF-INTERACTION OF THE ELECTRON. T.Tietz.

Acta phys. Hungar., Vol. 10, No. 2, 169-72 (1959).

Using the approximate Rozental solution (Abstr. 1492 of 1936) for the Thomas-Fermi function for free neutral atoms, a formula is derived for the phase shifts for the Thomas–Fermi potential, which does not include the electrostatic self-interaction of the electron. The derivation of this formula for the considered phase shift is similar to the Born method, and the difference consists only in the fact that instead of Bessel functions, hydrogenic functions are used.

539.18

5844 THE PENETRABILITY OF A THOMAS–FERMI POTENTIAL BARRIER. T.Tietz.

Acta phys. Hungar., Vol. 11. No. 1, 53-7 (1960).

The effect of the surrounding electrons on the nuclear barrier penetration probability is considered. Accepting the Thomas–Fermi potential barrier for a free neutral atom and using Langer's approximation (1937), the probability that a particle will penetrate the Thomas–Fermi potential barrier is calculated. The surrounding electrons cause a lowering of the barrier height and a decrease of the "thickness" to be penetrated. The theory is applied to the evaluation of the penetration probability of alpha particle.

539.18

5845 ATOMIC FORM FACTOR OF AN ELECTRON IN THE THOMAS–FERMI ATOM. T.Tietz.

J. chem. Phys., Vol. 31, No. 6, 1686-7 (Dec., 1959).

The author's analytic solution to the Schrödinger equation with an approximate T–F potential (Abstr. 1797 of 1959) is used to derive an analytic form factor for K electrons. J.Hawgood

539.18

5846 ESTIMATED ELECTRON AFFINITIES OF THE LIGHT ELEMENTS. G.Glockler.

J. chem. Phys., Vol. 32, No. 3, 708-9 (March, 1960).

Estimates are made of the electron affinities of the following elements: He(~+0.), Li(0.5), Be(~+0.), B(0.3), N(0.2), Ne(~+0.), Na(0.7), Mg(~+0.), Al(0.4), Si(1.9), P(0.8) eV. The known electron affinities of the other elements of the first two groups of the periodic table form the basis of the graphical method. It involves the variation of screening constants derived from the ionization potentials of isoelectronic sequences.

539.18

5847 ELECTRONIC STRUCTURE OF THE Po ATOM. R.Gáspár and K.Molnár.

Acta phys. Hungar., Vol. 7, No. 4, 455-62 (1957).

The eigenfunctions and energies of the electrons are determined with the aid of a universal potential field. Calculations of the diamagnetic susceptibility yield -45.683×10^{-6} cm^3 mol^{-1}.

539.18

5848 SELF-CONSISTENT FIELDS WITHOUT EXCHANGE FOR Pr^{3+} AND Tm^{3+}. E.C.Ridley.

Proc. Cambridge Phil. Soc., Vol. 56, Pt 1, 41-54 (Jan., 1960).

Self-consistent fields without exchange have been calculated for the ground state of Pr^{3+} and Tm^{3+}. The spin–orbit coupling constant $\zeta(4f)$ is found to have the values 785 and 2742 cm^{-1} in Pr^{3+} and Tm^{3+}, respectively. The corresponding values of $\overline{(1/r^3)}$ are 29.4 and 77.5 A^{-3}. Values of the Slater integrals $F^2(4f,4f)$, $F^4(4f,4f)$ and $F^6(4f,4f)$ are also given for each structure.

539.18 : 539.2

HARTREE–FOCK CALCULATIONS FOR Mn^{3+} IN CUBIC FIELDS. See Abstr. 4253

539.18

5849 ATOMIC POLARIZABILITIES. D.Parkinson.

Proc. Phys. Soc., Vol. 75, Pt 2, 169-73 (Feb., 1960).

An antisymmetrical Hartree approximation is applied to the calculation of the polarizabilities of lithium and beryllium and of various ions iso-electronic with atoms of the second row of the periodic table. The results are in harmony with the available experimental data.

539.18

5850 NOTE ON THE THEORY OF ATOMIC COULOMB EXCITATION. C.De Laet and M.Demeur.

Bull. Acad. Roy. Belgique Cl. Sci., Vol. 45, No. 6, 546-52 (1959). In French.

The semi-classical treatment of the electromagnetic excitation of a bound electron by a heavy charged particle is discussed. The peculiarities of the impact parameter method are compared with those of the Rutherford orbits method.

539.18

5851 MEASUREMENTS OF THE FLUORESCENT YIELD OF THE K-SHELL WITH A PROPORTIONAL COUNTER. H.L.Hagedoorn and A.H.Wapstra.

Nuclear Phys., Vol. 15, No. 1, 146-51 (Feb. [1], 1960).

Using a proportional counter in coincidence with a scintillation spectrometer, fluorescent yields in the K-shell were determined from measurements on nuclei decaying by electron capture. The following results were obtained:

$\omega_K(Ti) = 0.18 \pm 0.01$; $\omega_K(Cr) = 0.219 \pm 0.012$;
$\omega_K(Co) = 0.31 \pm 0.01$; $\omega_K(Zn) = 0.43 \pm 0.02$; $\omega_K(Sr) = 0.64 \pm 0.03$.

A new set of constants in the semi-empirical formula giving the relation between ω_K and Z was derived from these results in combination with earlier data.

539.18

5852 ELECTRON EXCITATION OF ATOMIC HYDROGEN IN THE 2p-LEVEL. D.McCrea and T.V.M.McKirgan.

Proc. Phys. Soc., Vol. 75, Pt 2, 235-42 (Feb., 1960).

Using an interpolation procedure, the Born approximation to the cross-sections for the excitation of atomic hydrogen from the

2p-level to the eighth and higher levels has been obtained from computed cross-sections for transitions to the lower discrete levels and to the continuum. The total ionization cross-sections have also been obtained. An incident energy range of from 5 eV to 120 eV is covered.

539.18

5853 EXCITATION OF THE S-LEVELS OF THE HYDROGEN ATOM. R.Peterkop.

Latv. PSR Zinat. Akad. Vestis, No. 10 (147), 91-6 (1959). In Russian.

Using the method of integral equations, the excitation of the S-levels in the discrete and continuous spectrum from the ground state by slow electrons is discussed under the assumption that the incident beam contains only S-waves. P.Roman

539.18

5854 NEW DATA ON EXCITATION FUNCTIONS OF HELIUM LINES. S.É.Frish and V.E.Yakhontova.

Optika i Spektrosk, Vol. 4, No. 3, 402-4 (1958). In Russian. English summary : PB 141047T-4 obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

The excitation functions for electronic excitation of 13 lines of He, all involving transitions to 2P or 2S (singlet and triplet) levels, have been measured, but do not allow definite conclusions to be drawn about separate levels. However, some statements can be made about the contributions of cascade transitions to the excitation functions. J.Hawgood

539.18

5855 ELECTRON COLLISION CROSS-SECTIONS IN HELIUM. D.T.Stewart and E.Gabathuler.

Proc. Phys. Soc., Vol. 74, Pt 4, 473-7 (Oct. 1, 1959).

Electron collision cross-sections in helium have been measured by an optical method, using a photoelectric spectrophotometer. The results are in general agreement with those of previous workers. Some values for the cross-sections for collisions of the second kind in helium are also given.

539.18 : 548.7 : 539.2

X-RAY INCOHERENT SCATTERING FUNCTIONS FOR 13 ATOMS AND IONS. See Abstr. 4620

539.18 : 539.16

MASSES OF $Pm^{141,142}$ AND $Sm^{142,143}$. See Abstr. 5689

539.18

5856 LIFETIME OF THE EXCITED STATE 6^3P_1 OF MERCURY VAPOUR FOR ISOTOPES WITH EVEN AND ODD MASS NUMBERS. L.J.Cojan and M.Thibeau.

C. R. Acad. Sci. (Paris), Vol. 249, No.16, 1489-91 (Oct. 19, 1959). In French.

Measurements of absorption of the 2537 A ($6^3P_1 - 6^1S_0$) mercury line by mercury vapours of different isotopic constitutions lead to the same value (1.16×10^{-7} sec) of lifetime of the 6^3P_1 state for each of the isotopes. Hg^{196}, Hg^{198}, Hg^{200}, Hg^{201}, Hg^{202}. R.W.Nicholls

539.18

5857 THE SEPARATION COEFFICIENT OF BORON ISOTOPES DURING EQUILIBRIUM EVAPORATION OF BCl_3. N.N.Sevryugova, O.V.Uvarov and N.M.Zhavoronkov.

J. nuclear Energy, Vol. 4, No. 4, 483-9 (April, 1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 4, 113 (1956).

The separation coefficients of the boron isotopes during equilibrium evaporation of boron trichloride have been determined over the temperature range + 12.7° to -85°C. An account is given of the method and an equation is obtained for the dependence of the separation coefficient on temperature of evaporation.

539.18

5858 THE TEMPERATURE DEPENDENCE OF THE ISOTOPE EFFECT OF CURRENT FLOW IN LIQUID ALKALI METALS. A.Lodding.

Z. Naturforsch., Vol. 14a, No. 11, 934-7 (Nov., 1959). In German.

The temperature dependence of the so-called "Haeffner effect" was investigated for potassium in the range 79° to 335°C. It was found that the mass effect, μ, increased up to ~ 250°C and decreased again for temperatures above ~ 300°C. This is in agreement with earlier investigators. Similar results were obtained for rubidium with a maximum at ~ 180°C. H.C.Cole

539.18 : 541.13

THE ELECTROMIGRATION OF RADIOACTIVE IONS IN FUSED SALTS. APPLICATION TO THE SEPARATION OF ISOTOPES. See Abstr. 4718

539.18

5859 A MOVABLE UNIVERSAL DETECTOR FOR ATOMIC BEAMS. H.Friedmann.

Z. Phys., Vol. 156, No. 4, 598-602 (1959). In German.

This detector works on the principle of chopping the atomic beam before allowing it to enter an ionization chamber. The output of the chamber is fed to a narrow-band amplifier. A particle density of 2×10^5 cm^{-3} is detectable at a residual pressure of 2×10^{-6} mm Hg. T.Mulvey

539.18 : 535.33

CORRECTION FOR SYSTEMATIC WAVELENGTH SHIFTS IN ATOMIC BEAM DEVICES. See Abstr. 5168

539.18

5860 PRODUCTION OF $H^-(1s^2)$ BY HYDROGEN ATOM COLLISIONS. R.A.Mapleton.

Phys. Rev., Vol. 117, No. 2, 479-85 (Jan. 15, 1960).

The post matrix element form of Born's approximation is used to calculate the cross-section for $H^-(1s^2)$ production in hydrogen atom collisions. The Coulomb wave-function is approximated by a plane wave, and two different wave-functions derived by Chandrasekhar, one of which contains the inter-electron distance, are used for the H^- state. The value of the cross-section obtained with the wave-function containing the interelectron distance term is roughly 25% larger than the other cross-section. Since the direct and exchange charge transfer amplitudes, $f_g(\theta)$ and $f_g(\pi-\theta)$, are sharply peaked about $\theta = 0$ and $\theta = \pi$, respectively, the interference terms are negligible. Thus, only $f_g(\theta)$ has to be calculated to obtain the cross-section.

539.18

5861 DRIFT MOBILITY OF ELECTRONS IN ATOMIC HYDROGEN. M.S.Sodha and Y.P.Varshni.

Canad. J. Phys., Vol. 37, No. 12, 1552-5 (Dec., 1959).

An expression for the drift mobility is obtained as a function of temperature by adopting a polynomial representation of the zero-order partial cross-section in terms of the velocity of the electron. At high temperatures it is found that the drift mobility varies linearly with temperature. R.A.Ballinger

539.18

5862 DRIFT VELOCITY OF ELECTRONS IN HELIUM. A.V.Phelps, J.L.Pack and L.S.Frost.

Phys. Rev., Vol. 117, No. 2, 470-4 (Jan. 15, 1960).

The drift velocity of electrons in helium at 300°K was measured for E/p values between 4×10^{-4} and 40 V/cm-mm Hg. The data for E/p < 1 V/cm-mm Hg were obtained from measurements of electron transit time in a modernized version of the double shutter tube developed by Bradbury and Nielsen. The data at high E/p were obtained from microwave measurements of the electron density in a positive column of a low-pressure discharge. The measured drift velocities are in good agreement with previous results in the E/p range from 10^{-1} to 3 V/cm-mm Hg. At E/p less than 3×10^{-2} V/cm-mm Hg the electrons are essentially in thermal equilibrium with the gas. Margenau's theoretical expression for the drift velocity of electrons in a gas for which the cross-section for momentum transfer is independent of electron energy is found to fit the data for E/p < 1 V/cm-mm Hg to the accuracy of measurements. The cross-section which gives the best fit of the theory to the data is 6×10^{-16} cm^2.

539.18 : 539.11

5863 UPPER BOUNDS ON SCATTERING LENGTHS FOR COMPOUND SYSTEMS: n–D QUARTET SCATTERING. L.Spruch and L.Rosenberg.

Phys. Rev., Vol. 117, No. 4, 1095-102 (Feb. 15, 1960).

For previous work, see Abstr. 2496, 4167 (1960). In the zero-energy scattering of a particle by a compound system under the conditions that (1) only one exit channel is open (elastic scattering) and (2) no composite bound state exists for the particle and the scattering system in the state of given total angular momentum, the Kohn variational principle gives an upper bound on the scattering length. This is one of several results given previously for the case of scattering by the centre of force which may be taken over directly, provided conditions (1) and (2) are satisfied. As a particular application of these results, several previous calculations of the n–D quartet

scattering length, A_Q, based on the Kohn principle (the method of Verde and the static approximation of Buckingham and Massey are included) are reanalysed using the rigorous criterion that the best result is the one giving the lowest value. Further, some calculations of AQ based on the Rubinow formulation, which do not necessarily provide a bound, are converted to the Kohn form, thereby obtaining, in addition to a bound, an improved approximation to the scattering length. Some limitations and possible extensions of the method are discussed.

539.18

5864 DIFFERENTIAL SCATTERING CROSS-SECTION OF ATOMS TO MEDIUM ENERGY ELECTRONS AT SMALL ANGLES. M.E.Haine and A.W.Agar.
Brit. J. appl. Phys., Vol. 10, No. 8, 341-6 (Aug., 1959).

The differential scattering cross-section of a range of atoms has been determined experimentally for angles between 10^{-2} and 10^{-1} rad. The results are in reasonably good agreement with the theory of Lenz.

539.18

5865 CALCULATIONS OF TOTAL CROSS SECTIONS FOR SCATTERING FROM COULOMB POTENTIALS WITH EXPONENTIAL SCREENING. G.H.Lane and E.Everhart.
Phys. Rev., Vol. 117, No. 4, 920-4 (Feb. 15, 1960).

For previous work, see Abstr. 8845 (1955). Momentum transfer cross-sections and total cross-sections are calculated for scattering from the potential energy function $V = (Z_1Z_2e^2/r)\exp(-r/a)$. Here the first factor is the Coulomb term and the exponential factor contains a screening length a. The cross-sections are obtained by integrating the differential cross-section over all angles using a classical calculation or a Born approximation calculation according to whichever is valid. The validity criteria are discussed as they depend on the de Broglie wavelength of the scattered particle. In certain cases the Born approximation solution is valid at small angles and the classical solution is valid at large angles. Graphs and tables are presented showing the results as functions of suitable parameters. The momentum transfer cross-section is finite in all cases and the total cross-section is finite except in the classical limit. In this limit, however, calculations are presented showing that portion of the total cross-section which arises from scattering through angles greater than a specified small angle.

539.18

5866 THE ANGULAR DISTRIBUTION IN SCATTERING EXPERIMENTS ON MOLECULAR BEAMS.
E.Gersing, R.Jaeckel and H.Pauly.
Z. Naturforsch., Vol. 14a, No. 12, 1083 (Dec., 1959). In German.

The differential cross-section for single scattering of potassium atoms by mercury atoms was measured experimentally over an angular range of 5° to 150°. The results are in good agreement with theoretical predictions by Mason except for angles greater than 70°. This can be attributed to diffraction effects in the scattered beam.
A.E.I. Research Laboratory

539.18

5867 A THEORETICAL ESTIMATION OF THE INTERACTION ENERGY OF INERT GAS ATOMS. R.Gáspár.
Acta phys. Hungar., Vol. 11, No. 1, 71-80 (1960).

Uses statistical methods. Reasonable agreement is obtained with the existing experimental data.
W.J.Orville-Thomas

539.18

5868 MECHANISM OF ATOM RECOMBINATION. G.Porter and J.A.Smith.
Nature (London), Vol. 184, 466-7 (Aug. 8, 1959).

The temperature coefficients of iodine atom recombination in nine different gases were determined. Results indicate that an intermediate complex is initially formed when two atoms recombine in the presence of a chaperon gas. G.I.W.Llewelyn

539.18

5869 DISTORTED WAVE METHOD FOR ELECTRON CAPTURE FROM ATOMIC HYDROGEN.
R.H.Bassel and E.Gerjuoy.
Phys. Rev., Vol. 117, No. 3, 749-56 (Feb. 1, 1960).

The distorted wave method, in which distorted waves replace plane waves in the matrix elements for the collision amplitude, is given a rigorous formulation for arbitrary rearrangement collisions. In atomic collisions involving electron rearrangement, the formulation enables removal of the unphysical internuclear Coulomb interaction from the "perturbation" Hamiltonian. The procedure is applied to the problem of electron capture by protons in atomic hydrogen, eliminating explicit dependence on the proton–proton interaction. Numerical results of a first order calculation are in good agreement with experiments from 35 to 200 keV. Despite this agreement and the agreement of previous calculations it is felt the charge transfer process is still not well understood. See also Abstr. 5996 (1960).

539.18 : 539.19

5870 THEORETICAL CALCULATIONS ON LIGHT ATOMS AND MOLECULES USING THE VARIATION METHOD.
B.Kockel.
Z. Naturforsch., Vol. 14a, No. 12, 1088-97 (Dec., 1959). In German.

The various attempts to obtain theoretical estimates of spectroscopic terms are discussed with special reference to atomic and molecular hydrogen, to He in the ground and excited states, and to all atoms and ions from Li to Ne. Calculated and experimental values are quoted. W.J.Orville-Thomas

539.18

5871 CALCULATION OF THE DEGREE OF POLARIZATION OF RESONANCE FLUORESCENCE FROM APPEARANCE OF RADIATION DIFFUSION. I. R.Seiwert and W.Ermisch.
Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 1-2, 4-14 (1959).
In German.

If the resonance fluorescence radiation is reabsorbed within the containing vessel then the directional absorption and emission processes for π and σ transitions suffers a depolarization effect. In addition depolarization is present in the Zeeman effect. Equations are given for the calculation of the degree of polarization of resonance fluorescence for very weak magnetic fields and weak reabsorption of the radiation. G.F.J.Garlick

539.18

5872 CALCULATION OF THE DEGREE OF POLARIZATION OF RESONANCE FLUORESCENCE FROM APPEARANCE OF RADIATION DIFFUSION. II. R.Seiwert and W Ermisch.
Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 1-2, 15-30 (1959).
In German.

The equations established in paper I (see preceding abstract) are applied to three cases for which experimental data are available There is good agreement between theory and experiment considering the theoretical simplicity assumed. This indicates that for very small partial pressures the depolarization is due to diffusion of radiation. G.F.J.Garlick

539.18

5873 ON A SCREENING THEORY OF ATOMIC SPECTRA. D.Layzer.
Ann. Phys. (New York), Vol. 8, No. 2, 271-96 (Oct., 1959).

A theoretical scheme for describing atomic spectra is developed. It differs from the current one in three main ways. (1) The nuclear charge Z enters explicitly into all predictions made with the new scheme. (2) Certain effects of configuration interaction are allowed for in the first approximation. Spectroscopic terms are no longer assigned to definite configurations in the first approximation, but rather to more comprehensive aggregates called complexes, specified by a set of radial quantum numbers and a definite value of the parity. (3) The notion of screening takes on a precise quantitative meaning, and the predictions of the theory are expressed largely in terms of screening parameters. The new scheme is simpler than one based on the central-field approximation and Hartree–Fock wave functions, and in some ways at least it is also more accurate. For example, its predictions concerning relative term energies are free of the large systematic discrepancies that show up when the current theory is used to describe term spectra.

539.18

5874 SELECTIVE PRESSURE BROADENING AND THE STARK EFFECT. L.I.Maissel.
Proc. Phys. Soc., Vol. 74, Pt 1, 97-100 (July 1, 1959).

Broadening of the spark lines from a condensed discharge in neon and argon has been compared with their Stark effects and good correlation obtained, indicating that Stark effect is important as a cause of line broadening for other elements besides hydrogen and helium.

539.18

5875 NOTES ON A PHOTOGRAPH OF THE STARK EFFECT. J.S.Foster.
Canad. J. Phys., Vol. 37, No. 10, 1202-3 (Oct., 1959).

Displacements of up to 100 cm^{-1} have been obtained in a field of 85 000 V cm^{-1} for the parahelium group $2\,^1P - 6\,^1$ (S,D,F,G,H,P), (λ4144). The photograph shows the π and σ polarized components. G.H.C.Freeman

539.18

5876 ABSOLUTE INTENSITY MEASUREMENTS OF THE CARBON AND ALUMINIUM X-RAY K-LINES WITH A PROPORTIONAL COUNTER. R.M.Dolby.
Brit. J. appl. Phys., Vol. 11, No. 2, 64-6 (Feb., 1960).

The efficiencies (quanta per electron per unit solid angle) of thick target carbon and aluminium X-ray K-line production, as a function of accelerating voltage, have been measured and plotted in the region below 10 kV. The construction and performance of the proportional counter with which the measurements were made is also described.

539.18

5877 ISOTOPE SHIFT IN THE Cd I INTERCOMBINATION RESONANCE LINE λ 3261 A. F.M.Kelly and E.Tomchuk.
Proc. Phys. Soc., Vol. 74, Pt 6, 689-92 (Dec., 1959).

The isotope shifts in the intercombination resonance line of Cd I have been measured. The line was excited in an atomic beam by electron bombardment and high resolution was obtained with a Fabry–Perot interferometer. The shifts between even isotopes decrease with increasing neutron number and the odd isotopes lie close to the next lighter even isotope showing a pronounced odd–even staggering. The relative shifts are in agreement with those of other Cd lines.

538.18

5878 EFFICIENCY OF CHARACTERISTIC K_α X-RAY PRODUCTION IN COPPER BETWEEN 9 AND 15 kV. N.A.Dyson.
Brit. J. appl. Phys., Vol. 10, No. 11, 505-7 (Nov., 1959).

Absolute measurements are described of the production of K_α characteristic X-radiation in copper, and the data are compared with existing information. The measurements (together with a single existing observation) cover a range of electron energies between 9 and 15 kV.

539.18

5879 RESEARCH ON THE HYPERFINE STRUCTURE OF ATOMIC SPECTRA AND ON THE FINE STRUCTURE OF HELIUM, USING A FABRY–PEROT SPECTROMETER WITH ONE OR TWO ETALONS. H.Chantrel.
Ann. Phys. (Paris), Ser. 13, Vol. 4, No. 7-8, 965-1016 (July-Aug., 1959). In French.

An instrument using two etalons is described, giving a greater dispersion than a single etalon. In view of the high sensitivity it is found possible to use very weak sources with consequently sharper lines. Some commercial sources are used but a hollow cathode source is also described which can be cooled in liquid helium. Conditions for stability are discussed together with results on the variation of intensities and line breadths with gas pressure and temperature. Investigations on the hyperfine structure and nuclear magnetic moments of Pd^{105}, Pb^{207}, Hg^{199}, and Hg^{201} are described. There is a detailed discussion of the theory of the fine structure of He^4 and this is compared with present and previous measurements. The case of He^3 is difficult since fine and hyperfine structures are comparable and serious perturbation results, but some significant measurements are quoted. A list of 60 references to previous work, some by the author, is given. A.H.Gabriel

539.18

5880 HYPERFINE STRUCTURE OF THE MERCURY LINE 6123 A ($5d^96s^26p\,^1D_2^0 \rightarrow 6s7s\,^3S_1$). J.L.Cojan and P.Giacomo.
C.R.Acad. Sci. (Paris), Vol. 294, No. 25, 2752-4 (Dec. 21, 1959). In French.

The analysis of the hyperfine structure permits the determination of the constants of magnetic and quadrupole coupling of the level $^1D_2^0$ for the isotopes $Hg^{199,201}$. One finds $A_{201} = -22.3$ mK, $B_{201} = -25.2$ mK, $A_{199} = 59.6$ mK. G.H.C.Freeman

539.18

5881 PRESSURE EFFECTS OF HELIUM AND ARGON ON THE FIRST SHARP SERIES DOUBLET OF INDIUM. Shang-Yi Ch'en, A.Smith and M.Takeo.
Phys. Rev., Vol. 117, No. 4, 1010-16 (Feb. 15, 1960).

The shift, half-width, and asymmetry of the In λ 4101 and λ 4511 lines produced by various pressures of helium and argon up to 120 atm and the appearance of satellite bands near these lines are described. The entire absorption line contours and the wings of the pressure-broadened lines were studied. The experimental observations were compared with the Anderson–Talman theory at general pressures.

539.18

5882 THE EFFECT OF HIGH ARGON PRESSURES ON THE RESONANCE EMISSION OF THE POTASSIUM SPECTRUM AND THE SATELLITE BANDS IN THE NEIGHBOURHOOD OF THE K, Rb AND Cs LINES. J.Robin.
J. Phys. Radium, Vol. 18, No. 11, 639-40 (Nov., 1957). In French.

A study of the appearance of diffuse lines on the high frequency side of the resonance regions in the spectra of alkali metals, induced by inert gases under pressures up to 1500 atm. S.J.St-Lorant

539.18

5883 THE INFRARED SPECTRUM OF Li I. I.Johansson.
Ark. Fys., Vol. 15, Paper 14, 169-79 (1959).

Measurements have been made in the arc spectrum Li in the region 7000-27 000 A. The spectrum was excited in a hollow cathode and recorded photographically up to 12 000 A with a concave grating spectrograph, and beyond 12 000 A by means of a PbS photoconductive cell in a Pfund-type scanning spectrograph. On the basis of the present data together with interferometer measurements by Meissner, Mundie and Stelson (Abstr. 1810, 6078 of 1949) the term system is revised and accurate formulae are derived for the various term series.

539.18

5884 ISOTOPE SHIFT IN THE Mo SPECTRUM. H.Arroe and J.M.Cornwall.
Phys. Rev., Vol. 117, No. 3, 748 (Feb. 1, 1960).

The isotope shift in the molybdenum spectrum was measured with a Fabry–Perot interferometer, using separated isotopes. For the line 16 578 K, a definite minimum isotope shift of −8.9 mK was observed between Mo^{96} and Mo^{97}. The negative sign indicates that the direction of the shift is opposite to that predicted by the volume effect.

539.18

5885 INTERPRETATION OF ISOTOPE SHIFTS IN THE RARE GASES. A.P.Stone.
Proc. Phys. Soc., Vol. 74, Pt 4, 424-31 (Oct. 1, 1959).

A successful qualitative interpretation of observed isotope shifts in atomic spectra of Ne, A, Kr, Xe is obtained by considering the specific mass effect in intermediate coupling.

539.18

5886 SPECTRA OF TRIVALENT PRASEODYMIUM AND THULIUM IONS. W.A.Runciman and B.G.Wybourne.
J. chem. Phys., Vol. 31, No. 4, 1149-50 (Oct., 1959).

A least-squares method using experimental data is used to determine new values of the parameters from which the matrix elements are calculated. It is found that the results with and without orbit–orbit interaction do not differ appreciably and the results are compared with those of other workers. R.A.Ballinger

539.18

5887 MEASUREMENT OF THE ABSOLUTE TRANSITION PROBABILITIES OF SOME LINES OF SILICON I, SILICON II, CHLORINE I AND CHLORINE II. P.Hey.
Z. Phys., Vol. 157, No. 1, 79-88 (1959). In German.

HCl and $SiCl_4$ are fed into a stabilized arc and the spectrum photographed with a stepped filter. Intensities are compared with the Hβ line. Transition probabilities are calculated for 11 lines in the range 3850-6370 A. G.F.Lothian

539.18

5888 PERTURBATION OF THE SPECTRUM OF THALLIUM VAPOUR BY COMPRESSED ARGON AND HYDROGEN. C. Weitkamp and J.Robin.
C.R. Acad. Sci. (Paris), Vol. 249, No. 14, 1205-7 (Oct. 5, 1959). In French.

A study of the perturbation of the absorption spectra of thallium vapour by argon and hydrogen at pressures up to 1250 and 900 atm. respectively. The lines at 3776 and 5350 A are displaced towards the red by argon and toward the blue by hydrogen. A satellite band appeared near the 3776 A line. G.H.C.Freeman

539.18

5889 NEW DATA ON THE X-RAY EMISSION SPECTRA OF TITANIUM IN SEVERAL HYDRIDES, CARBIDES AND NITRIDES. É.E.Vainshtein and E.A.Zhurakovskii.
Dokl. Akad. Nauk SSSR, Vol. 128, No. 4, 695-7 (Oct. 1, 1959). In Russian.

The new data were obtained by the fluorescence method which eliminates the danger of specimen over-heating. The results obtained confirm previous measurements (Abstr. 9228 of 1957) and reveal that the nitride and carbide but not the hydride are stable when heated. In the hydride the presence of a $K\beta$ line has been observed. The significiance of this result is discussed.

T.Mulvey

539.18

5890 ISOTOPIC DISPLACEMENTS IN THE SPECTRUM OF URANIUM. M.Diringer.
C.R. Acad. Sci. (Paris), Vol. 250, No. 5, 828-30 (Feb. 1, 1960). In French.

A table is given of the isotopic displacements of U^{235}, for 78 lines between 3876 and 5986 A. Some conclusions are drawn about the electronic configurations of the lowest lying odd-states.

P.A.Young

539.18 : 539.19

O I AND O II SPECTRA EXCITED BY 0.5-1 MeV PROTONS. See Abstr. 5942

539.18

5891 PHOTOELECTRIC EFFECT IN Pb AT HIGH ENERGIES. R.H.Boyer.
Phys. Rev., Vol. 117, No. 2, 475-8 (Jan. 15, 1960).

A formula for the photoelectric absorption cross-section for the K shell is derived using the Furry or Sommerfeld–Maue approximate wave-function. The surviving terms at the high-energy limit are given explicitly and the value for the cross-section is found for Pb by numerical integration. The exact wave-function is rewritten so as to simplify the derivation of the Furry approximation.

539.18

5892 ATOMIC PHOTOELECTRIC EFFECT AT HIGH ENERGIES. R.H.Pratt.
Phys. Rev., Vol. 117, No. 4, 1017-28 (Feb. 15, 1960).

Total cross-sections are obtained for the photoelectric effect from the K shell of an atom of arbitrary charge, in the limit of high energies. An approximate analytic formula then is deduced to cover the entire high-energy region. For heavy elements and very high energies the differences from previous predictions are large. It is noted that these results also apply to other processes, including the one-photon annihilation of fast positrons.

MOLECULES

539.19

5893 VIBRATIONAL RELAXATION AND DISSOCIATION OF CARBON DIOXIDE BEHIND SHOCK WAVES. I.R.Hurle and A.G.Gaydon.
Nature (London), Vol. 184, 1858-9 (Dec. 12, 1959).

Time resolved measurements by sodium-line reversal show a low initial temperature, a quick rise to a high value, near that calculated for no dissociation, and slow (350 to 600 μs) decay towards equilibrium at about 2420°K. Addition of 2% water vapour reduces the dissociation time to 100 μs. The initial low temperature may be due to separate vibrational relaxation of the asymmetrical mode ν_3 of CO_2; times are given for this.

A.G.Gaydon

539.19 : 539.18

THEORETICAL CALCULATIONS ON LIGHT ATOMS AND MOLECULES USING THE VARIATION METHOD. See Abstr. 5870

539.19

5894 CALCULATION OF THE INTERNAL PARTITION FUNCTIONS OF DIATOMIC MOLECULES AT HIGH TEMPERATURES. F.Burhorn and R.Wienecke.
Z. phys. Chem. (Leipzig), Vol. 212, No. 1-2, 105-17 (1959). In German.

The total internal partition functions, consisting of electronic, vibrational, and rotational contributions, have been calculated at temperatures between 1000° and 10 000°K for the following diatomic molecules : N_2, CO, O_2, CN, C_2, NO, and H_2. The effects of anharmonicity and centrifugal stretching were taken into account.

W.J.Orville-Thomas

539.19

5895 SPECTROSCOPIC CONSTANTS OF MOLECULES. VI. DEPENDENCE OF FORCE CONSTANT ON ELECTRONEGATIVITY. Y.Pal Varshni.
Indian J. Phys., Vol. 32, No. 1, 1-9 (Jan., 1958).

For Pt V, see Abstr. 8305 (1956). For diatomic molecules formed out of elements belonging to the same sub-group of the periodic table, it is shown that

$$\log k_e = g \log x_A x_B + h$$

where g and h are constants and x_A and x_B are the electronegativities. A relation between the force constants of diatomic molecules AA and AH is also suggested:

$$k_e(AH) = pk_e(AA) + q$$

where p and q are constants for each group.

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5896 STABILITIES OF THE GASEOUS MOLECULES, BiSe, BiTe, AND SbTe. R.F.Porter and C.W.Spencer.
J. chem. Phys., Vol. 32, No. 3, 943-4 (March, 1960).

A method involving the mass spectrometric identification of the vapour species escaping from an effusion cell was used to obtain values for ΔF, ΔS, and ΔH for the reaction $M_2(g) + Y_2(g) = 2MY(g)$ (where M and Y are Bi, Sb, Se, or Te). Dissociation energies for the various diatomic species were calculated by combining spectroscopic or thermochemical values for $M_2(g)$ and $Y_2(g)$ with the ΔH values obtained thermochemically.

W.J.Orville-Thomas

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5897 MEAN SQUARE AMPLITUDES AND FORCE CONSTANTS OF TETRAHEDRAL MOLECULES. I. CARBON TETRACHLORIDE AND GERMANIUM TETRACHLORIDE. Y.Morino, Y.Nakamura and T.Iijima.
J. chem. Phys., Vol. 32, No. 3, 643-52 (March, 1960).

The atomic distances and mean square amplitudes of carbon tetrachloride and germanium tetrachloride were measured by the sector-microphotometer method of electron diffraction. The force constants were calculated by use of the mean square amplitudes thus obtained, combined with the normal frequencies. The results indicate that a force field of the Urey–Bradley type is approximately realized in these molecules.

539.19

5898 FORCE CONSTANTS OF METHANE. INFRARED SPECTRA AND THERMODYNAMIC FUNCTIONS OF ISOTOPIC METHANES. L.H.Jones and R.S.McDowell.
J. molecular Spectrosc., Vol. 3, No. 6, 632-53 (Dec., 1959).

General quadratic valence force constants have been calculated for the symmetrical methanes (CY_4) using the most recent experimental data. The F and G matrix elements are given for the isotopic species CY_3Z and CY_2Z_2 (Y and Z are H, D, or T). The fundamental frequencies of CY_3Z and CY_2Z_2 were calculated using the CY_4 force constants. Most of the fundamental frequencies of these isotopic methanes were observed. The anharmonic corrections are discussed. From the force constants, zeta values were calculated for the degenerate vibrations of CY_3Z. The thermodynamic quantities $-(F^\circ - E_0^\circ)/T$, $(E^\circ - E_0^\circ)/T$, S°, C_p°, and equilibrium constants for the various H, D, and T isotope exchange equilibria are given at seven temperatures from −180° to +1000°C.

539.19

5899 RELATIONS BETWEEN FORCE CONSTANTS, BOND ORDERS, BOND LENGTHS, AND BOND FREQUENCIES FOR SOME NITROGEN–OXYGEN BONDS. N.B.H.Jonathan.
J. molecular Spectrosc., Vol. 4, No. 1, 75-83 (Jan., 1960).

Self-consistent molecular orbital bond orders for a number of the simpler nitrogen–oxygen compounds have been calculated. Attempts are made to correlate bond lengths and force constants, with bond orders for these molecules. An attempt is also made to correlate the stretching NO frequencies with the force constants and bond lengths for these simple oxides.

539.19

5900 POTENTIAL CONSTANTS OF $VOCl_3$. P.Babu Rao and K.Sreerama Murty.
Curr. Sci., Vol. 29, No. 1, 14 (Jan., 1960).

The force constants occurring in the quadratic potential function governing the vibrations of $VOCl_3$ are calculated. Amongst the values obtained are f(V = O) = 7.85 and f(V–Cl) = 1.409×10^5 dynes/cm. W.J.Orville-Thomas

539.19

5901 THE VIBRATING MEMBRANE, ITS RELATION AND APPLICATION TO MOLECULAR PHYSICS. H.Dehnert.
Frequenz, Vol. 13, No. 9, 289-304 (Sept., 1959). In German.

Points out that problems such as the absorption of light by dyestuffs can be readily studied by an analogue computer of the stretched-membrane type. Unfortunately, it is difficult to find a satisfactory membrane material. This difficulty can be overcome by replacing the membrane by a mesh of coiled springs. Two machines working on these lines are described, together with an application of the method to determining the absorption maximum of benzene. A.E.I. Research Laboratory

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5902 SIMPLIFIED ANALYTICAL REPRESENTATION OF KLEIN–DUNHAM POTENTIAL ENERGY FUNCTIONS. W.R.Jarmain.
J. chem. Phys., Vol. 31, No. 4, 1137-8 (Oct., 1959).

Rees' analytical treatment of the Klein–Rydberg potential has been generalized, and, except for cases when only two vibrational constants are known or higher order constants are insignificant, the computations are greatly simplified. It has been established that the Dunham potential is identical with that of Klein–Rydberg. R.A.Ballinger

539.19

5903 ANGULAR MOMENTUM IN N-DIMENSIONAL SPACES. G.A.Gallup.
J. molecular Spectrosc., Vol. 3, No. 6, 673-82 (Dec., 1959).

The matrix elements of the square of the generalized, n-dimensional angular momentum tensor have been obtained by an extension of Dirac's method. These were found to be $\hbar^2 j(j + n - 2)$, in agreement with the results of Narumi and Nakau (1951). The representation displayed is one appropriate to the consideration of spaces of even and odd dimensionality separately. Values of elements of non-diagonal matrices have been determined for spaces of 3, 4, 5, and 6 dimensions.

539.19

5904 ATOMIC POLARIZATION. I. VIBRATIONAL POLARIZATION OF GASES. K.H.Illinger and C.P.Smyth.
J. chem. Phys., Vol. 32, No. 3, 787-98 (March, 1960).

A derivation is given for the vibrational polarization and the vibrational polarizability of a molecule in several degrees of approximation. From the expressions derived, the vibrational polarization is calculated for a large number of molecules. A discussion, within the framework of the present derivation, is given of the atomic polarization, and a detailed comparison with previous theories is made.

539.19

5905 THE CALCULATION OF THE ENERGY LEVELS OF NEARLY SYMMETRIC ROTORS. S.C.Wait, Jr. and M.P.Barnett.
J. molecular Spectrosc., Vol. 4, No. 2, 93-8 (Feb., 1960).

A method is given for extending the King et al. (Abstr. 1145 of 1943) tables of coefficients for calculation of the energy levels of nearly symmetric rotor molecules. The method is general and may be applied to any secular determinant of continuant form. In addition it may be used for any desired order of approximation and is not limited by the size of the secular determinant. Values of the coefficients up to the seventh-order approximation and for $J \leq 51$ have been obtained.

539.19

5906 VIBRATIONAL INTERACTION IN CHAIN MOLECULES. R.Zbinden.
J. molecular Spectrosc., Vol. 3, No. 6, 654-63 (Dec., 1959).

A linear set of N coupled oscillators is considered as a classical model for a chain molecule. One oscillator in the model corresponds to a specific group vibration which is split into N components due to the interaction between the oscillators. The frequencies are expressed as a function of oscillator and coupling-force constants. Calculations of the relative intensity distribution in the infrared absorption spectrum of such a system show that one would expect to observe a band series which sometimes has the strongest peak at the lowest frequency. For some models the position of this strongest band is shifted towards lower frequencies with increasing chain length. The calculations are compared with observed spectra.

539.19

5907 CORRELATION OF RATES OF INTRAMOLECULAR TUNNELING PROCESSES, WITH APPLICATION TO SOME GROUP V COMPOUNDS. R.S.Berry.
J. chem. Phys., Vol. 32, No. 3, 933-8 (March, 1960).

A method is presented whereby the W.K.B. expression for tunnelling frequencies permits correlation of these frequencies for members of homologous series of molecules. The necessary data required are the tunnelling rate for one member of the series, and structural parameters and vibrational frequencies for all members of interest. The method is applied to ND_3, NF_3, PH_3, and AsH_3, using NH_3 as the molecule whose frequency is known. The method is also used to support the hypothesis that pseudorotation occurs in the trigonal bipyramids PF_5 and PCl_5.

539.19

5908 G MATRIX FOR XY_3–UW_3 AND $WZXY_3$ MOLECULES. M.Randic and I.M.Mills.
J. chem. Phys., Vol. 31, No. 6, 1681-2 (Dec., 1959).

G matrices for the E class vibrations of XY_3–UW_3 and $WZXY_3$ molecules, including the elements representing kinetic coupling of the end groups, are given. W.J.Orville-Thomas

539.19

5909 MEAN AMPLITUDES OF VIBRATION OF THE BENZENE RING. S.J.Cyvin.
J. molecular Spectrosc., Vol. 3, No. 5, 467-72 (Oct., 1959).

The mean amplitudes of vibration for the C–C distances in benzene and benzene-d_6 are calculated by an approximate method. The treatment is based on adopting a six-particle regular plane hexagonal model for the molecules. The results are in general agreement with rigorously calculated values, the discrepancies being about –0.003 A for the bonded C–C distances, –0.001 A for the nonbonded C_1–C_2, and +0.0005 A for the nonbonded C_1–C_4 distances.

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5910 CALCULATION OF THE PLANAR NORMAL VIBRATIONS OF P-DICHLOROBENZENE AND ITS DEUTERATED DERIVATIVE. S.Sałęki.
C.R. Acad. Sci. (Paris), Vol. 249, No. 23, 2537-9 (Dec. 9, 1959). In French.

The GF matrix method of Bright Wilson together with a Urey-Bradley force field has been used to calculate frequencies for the planar normal vibrations of p-dichlorobenzene and its deuterated derivative. With assumed values for thirteen potential constants, values for thirty-one frequencies are calculated. In general the agreement between calculated and observed frequency values is good. W.J.Orville-Thomas

539.19

5911 BARRIER TO ROTATION ABOUT THE METAL-CYCLOPENTADIENYL BOND. J.S.Waugh, J.H.Loehlin, F.A.Cotton and D.P.Shoemaker.
J. chem. Phys., Vol. 31, No. 5, 1434-5 (Nov., 1959).

The proton resonance of bis- (cyclopentadienylmolybdenum tricarbonyl) $[CpMp(CO)_3]_2$, has been examined between 77° K and room temperature. A graph showing the variation of ΔH_2^2 with temperature is given. The results at low temperatures are in agreement with calculations for a rigid lattice, but on account of the difficulties at these temperatures however, approximations have been made. R.A.Ballinger

539.19

5912 ESTIMATION OF THE HEIGHT OF THE POTENTIAL BARRIER OF [INTERNAL] HINDERED ROTATION IN THE CH_3SH [METHYL MERCAPTAN] MOLECULE BY MEANS OF THERMAL NEUTRON SCATTERING. A.Budzanowski, K.Grotowski, J.A.Janik, W.Kolos, F.Maniawski, H.Rèany, A.Szkatuła and A.Wanic.
Acta phys. Polon., Vol. 16, No. 5, 335-42 (1957).

The potential barrier height H was estimated by means of a method based on the scattering of thermal neutrons with a Maxwellian energy distribution (mean neutron energy E = 0.037 eV). The cross-section of CH_3SH molecules measured by thermal neutron scattering was $\sigma = (194.5 \pm 5)$ barns. This was determined from the relative

attenuation of the beam. Water was used as a standard liquid (σ_w = = 91 barns). The cross-section for rigid CH_3SH molecules calculated on the basis of the theory of Sachs and Teller (Abstr. 2178 of 1941), is 258 barns. Assuming a potential barrier height of H = = 705 cal/mol and taking into account the hindered rotation and the vibration of the atoms, the cross-section of the CH_3SH molecules is calculated as 202 barns. The cross-section for collisions that are elastic with regard to hindered rotation is also calculated on the assumption that H = 1460 cal/mol, this value being obtained by thermodynamical methods. It is concluded that a height of 705 cal/mol found by microwave spectroscopic methods should be ascribed to the potential barrier in the methyl mercaptan molecule, rather than the value obtained by thermodynamical methods.

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5913 INTERNAL ROTATION AND MICROWAVE SPECTROSCOPY. C.C.Lin and J.D.Swalen.
Rev. mod. Phys., Vol. 31, No. 4, 841-92 (Oct., 1959).

Analysis of rotational fine structure observed under high resolution in the microwave region permits determination of barriers to internal rotation in molecules. The work of the last ten years in this field is reviewed. Methods of formulating the Hamiltonian for various models are given and calculations of eigenvalues and eigenfunctions based on different approximations discussed and compared. Characteristics of these spectra are discussed and sample calculation of barrier heights given. The application of group theory to selection rules and the choice of nuclear-spin functions is described. Finally the experimental values of barrier heights obtained by these methods are reviewed. There are a number of appendices on the mathematical methods used. R.C.Seymour

539.19

5914 ROTATIONAL SPECTRUM OF $K^{39}F$ BY THE MOLECULAR BEAM ELECTRIC RESONANCE METHOD.
G.W.Green and H.Lew.
Canad. J. Phys., Vol. 38, No. 3, 482-94 (March, 1960).

Transitions between the J = 0 and J = 1 rotational states of $K^{39}F$ have been measured by means of the molecular beam electric resonance method. The following rotational constants have been determined (all frequencies in Mc/s): $Y_{01} \cong B_v$, 8392.312 ± 0.006; $-Y_{11} \cong \alpha_v$; 69.991 ± 0.010; $Y_{21} \cong \gamma_v$, 0.204 ± 0.005; B_v, 8392.482 ± ± 0.070. The quadrupole interaction constants eqQ as measured in the J = 1 state are found to be v = 0, −7.932 ± 0.003 Mc/s; v = 1, −7.835 ± 0.010 Mc/s. The equilibrium internuclear distance obtained directly from B_v is r_v = (2.17144 ± 0.00005) × 10^{-8} cm. The electric dipole moment in the v = 0 state is μ_E = (8.60 ± 0.09) × × 10^{-18} e.s.u.

539.19

5915 MICROWAVE ABSORPTION IN COMPRESSED OXYGEN. A.A.Maryott and G.Birnbaum.
J. chem. Phys., Vol. 32, No. 3, 686-91 (March, 1960).

Precise measurements of the absorption in oxygen resulting from the small magnetic dipole moment are reported at frequencies near 2, 3, 9, and 23 kMc/s and at pressures in the range from 3 to 70 atm. Up to 10 atm the resonant contribution agrees with the Van Vleck–Weisskopf theory and the line width increases in proportion to the pressure. The line width (relaxation frequency) for the nonresonant contribution also increases in proportion to the pressure, but is only about one-third as large as the resonant line width. Above 20 atm the resonant absorption shows anomalous behaviour resembling that previously noted in the case of the inversion spectra of NH_3 and ND_3. In particular, the resonant frequency appears to decrease rapidly while the line width changes much less rapidly than the pressure.

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5916 THEORY OF MICROWAVE ABSORPTION BY COMPRESSED OXYGEN GAS. M.Mizushima.
J. chem. Phys., Vol. 32, No. 3, 691-7 (March, 1960).

A theoretical explanation of the deviation between observed microwave absorption by high-pressure oxygen gas and the prediction by the simple Van Vleck–Weisskopf theory is attempted. The nonspherical part of the intermolecular force is considered and the distortion of energy levels and wave-functions is calculated. It is found that the nonresonant absorption vanishes and a low-frequency (~10 kMc/s) resonance appears at high pressure, while the 60 kMc/s resonance does not change much. This theory explains the observed data.

539.19

5917 THE MICROWAVE SPECTRA OF ISOTOPIC MOLECULES OF SULPHUR DIOXIDE. W.E.Smith.
Austral. J. Phys., Vol. 12, No. 2, 109-15 (June, 1959).

Some new lines in the spectra of $S^{34}O_2$ and $S^{33}O_2$ have been measured and accounted for in terms of a semi-rigid rotor model with centrifugal distortion coefficients derived from Kivelson's (Abstr. 7612 of 1954) published figures for $S^{32}O_2$, and rotational constants obtained from the measurements. The hyperfine structure of the $S^{33}O_2$ $1_{11} - 2_{02}$ transition has been analysed and found to agree with the quadrupole coupling constants of Bird and Townes (Abstr. 7622 of 1954).

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5918 ON SOME PHENOMENA RELATED TO THE SATURATION OF ROTATIONAL RESONANCES IN THE MICROWAVE SPECTRUM OF OCS.
A.Battaglia, A.Gozzini and E.Polacco.
Nuovo Cimento, Vol. 14, No. 5, 1076-81 (Dec. 1, 1959).

One experiment is described, which shows the interaction between two electromagnetic fields E_1 and E_2 propagating in a gas, their frequencies ν_1 and ν_2 being close to the frequencies $\nu_{J-1,J}$ and $\nu_{J,J+1}$ of two adjacent rotational resonances, and their intensity being sufficient to perturb appreciably the thermal equilibrium. The shape and the intensity of the line $J \rightarrow J+1$ is modified by the presence of the saturating field of frequency ν_1. Moreover a new resonance is observed, at a frequency $(E_{J+1}-E_{J-1})/h-\nu_1$. This is interpreted as a two quantum effect, i.e. as a transition between the J − 1 and the J + 1 levels produced by simultaneous absorption of a photon of frequency ν_1 and a photon of frequency ν_2.

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5919 ON SOME PHENOMENA RELATED TO THE SATURATION OF ROTATIONAL RESONANCES.
A.Di Giacomo.
Nuovo Cimento, Vol. 14, No. 5, 1082-92 (Dec. 1, 1959).

The statistical operator is calculated for a gas with rotational levels, in the presence of two electomagnetic waves with frequencies in the neighbourhood of two continuous resonances. The absorption coefficient is determined for the two waves. The agreement with experiment is good.

539.19 : 539.17

SLOW-NEUTRON SCATTERING BY MOLECULAR ROTATORS.
See Abstr. 5780

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5920 ABSORPTION OF MICROWAVES IN ETHYL CHLORIDE. G.P.Srivastava.
Proc. Phys. Soc., Vol. 74, Pt 4, 401-7 (Oct. 1, 1959).

Pressure variation of the microwave absorption coefficient of ethyl chloride in the vapour state has been studied at frequencies of 0.29 cm^{-1} and 1.14 cm^{-1}. It has been found that Van Vleck and Weisskopf's (1945) theory of absorption due to pressure broadened lines can explain approximately the pressure variation up to one atmosphere pressure in this case. The allowed rotational frequencies of the Q- and R-branches have been computed from the rotational constants of ethyl chloride. The intensities of various transitions have been calculated with the help of tables of Cross, King and Hainer (1944). The absorption due to these transitions have been calculated at 0.29 cm^{-1}, 0.8 cm^{-1} and 1.14 cm^{-1}. The absorption at 0.29 cm^{-1} is found to be entirely due to Q-branch transitions which are nearly at zero wave-number. At 0.8 cm^{-1} the absorption due to R-branch transitions has to be taken into account. At 1.14 cm^{-1} the calculated value is about 37.5% lower than the experimental value if the absorption due to only Q- and R-branches transitions is taken into account. An attempt is made to explain this discrepancy.

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5921 BEAM MASER SPECTROSCOPY ON FORMALDEHYDE. P.Thaddeus, J.Loubser, L.Krisher and H.Lecar.
J. chem. Phys., Vol. 31, No. 6, 1677-8 (Dec., 1959).

The hyperfine structures of the $2_{11} \rightarrow 2_{12}$ rotational transitions for CH_2O and CHDO were studied using a beam maser spectrometer. Values for the various hyperfine coupling constants are given.
W.J.Orville-Thomas

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5922 ROTATIONAL FINE STRUCTURE IN THE $^3A_2 \leftarrow {}^1A_1$, $\pi^* \leftarrow n$ TRANSITION OF FORMALDEHYDE.
V.E.DiGiorgio and G.W.Robinson.

J. chem. Phys., Vol. 31, No. 6, 1678-9 (Dec., 1959).

An analysis of the rotational fine structure in the $^3A_2 \leftarrow {}^1A_1$, $\pi^* \leftarrow n$ transition of H_2CO has provided confirmation of the vibrational assignment given earlier. The rotational analysis shows that the C–O bond is shorter in the triplet (1.31$_4$ A) than in the singlet (1.32$_8$ A) state. An estimate of the intensity indicated that the natural radiative lifetime of the triplet state is about 0.002 sec.

W.J.Orville-Thomas

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5923 INFRARED TEMPERATURE AND LINE STRENGTH MEASUREMENTS ON CARBON MONOXIDE EXCITED IN A RADIO-FREQUENCY DISCHARGE. D.R.Eaton.
Canad. J. Phys., Vol. 38, No. 3, 390-8 (March, 1960).

Relative line intensities in the 2 → 0 sequence of bands of carbon monoxide observed in emission from a radio-frequency discharge have been measured. An enhancement of the R branch lines and a diminution of the P branch lines due to vibration–rotation interaction has been observed in agreement with theoretical predictions. Vibrational and rotational temperatures have been calculated and when allowance is made for the vibration–rotation interaction these prove to be equal within experimental error indicating the existence of thermal equilibrium in the discharge.

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5924 THE EMISSION SPECTRUM OF CHLORINE (Cl_2^+). P.B.V.Haranath and P.Tiruvenganna Rao.
Indian J. Phys., Vol. 32, No. 9, 401-17 (Sept., 1958).

The emission spectrum of chlorine as excited in a high frequency discharge from a 100 W oscillator, is photographed in the visible region on Fuess and Hilger glass Littrow spectrographs. Photographs of the spectra reveal many more new bands, especially on the longer wavelength side. New vibrational analysis for these bands has been proposed. Most of the bands have been arranged into three systems designated as systems I, II, III having the vibrational frequencies of the upper and lower states approximately in the ratio of 1 : 2. The following vibrational constants are derived for all three systems: ν_0, ω_e', $x_e'\omega_e'$, ω_e'', $x_e''\omega_e''$. The occurrence of a fourth system consisting of the remaining unclassified bands is also suggested. From the equality of the vibrational constants of the lower states of systems I and II, it is concluded that they have a common lower level. The vibrational analysis of these emission bands is well supported by the observed chlorine isotope effect.

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5925 PRODUCTION AND STUDY OF THE OPTICAL SPECTRA OF DIATOMIC METAL MOLECULES [Cu_2, Ag_2, Au_2, MgAu, AlAu] AND CONTRIBUTION TO THE THEORETICAL CALCULATION OF INTENSITIES. J.Ruamps.
Ann. Phys. (Paris), Ser. 13, Vol. 4, No. 9-10, 1111-57 (Sept.-Oct., 1959). In French.

Gives details of the vibrational structure of several band-systems, observed in emission or absorption in a King furnace. Derived constants, in cm^{-1}, are as follows:-

Molecule	State	Te	ω_e	$x_e\omega_e$	$y_e\omega_e$
Ag_2	E	40 159.1	146.08	1.54	
	D	39 023.7	166.7	1.134	
	C	37 626.9	172.9	1.07	
	B	35 827.3	151.3	0.70	
	A	22 996.4	154.6	0.587	0.0022
	X	0	192.4	0.643	0.0003
Au_2	B	25 686.0	179.85	0.68	0.003
	A	19 668.1	142.3	0.445	−0.0015
	X	0	190.9	0.42	−0.0001
AuMg	B	19 491.4	338.5	1.46	0.009
	A	18 392.0	341.7	3.3	
	X	0	307.9	1.1	
AuAl	C	24 584.0	250	(2)	
	B	22 491.3	290.9	2.95	
	A	16 262.2	347.92	1.92	
	X	0	332.59	1.14	

A new perturbation treatment to give the wavefunctions of the anharmonic oscillator is presented and applied to a discussion of the relative intensities of bands in the Au_2 systems.

R.F.Barrow

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5926 PRESSURE-INDUCED SHIFTS OF HCl LINES DUE TO FOREIGN GASES.
D.H Rank, W.B.Birtley, D.P.Eastman and T.A Wiggins.
J. chem. Phys., Vol. 32, No. 1, 296-7 (Jan., 1960).

Shifts and broadenings of the R(0) and R(10) lines of the HCl band at 1.8 μ, induced by various foreign gases, are tabulated. The results compare satisfactorily with those of Hirshfeld, Kimel and Jaffe (Abstr. 9430 of 1959 and following abstract). G.F.Lothian

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5927 PRESSURE-INDUCED SHIFTS OF HCl LINES DUE TO FOREIGN GASES. M.A.Hirshfeld, J.H.Jaffe and S.Kimel.
J. chem. Phys., Vol. 32, No. 1, 297-8 (Jan., 1960).

Extension of previous work (Abstr. 9430 of 1959). Shifts of a number of lines in the P and R branches of the 1.8 μ band of HCl are reported. Admixture with polar gases (CO, SO_2 and CH_3Cl) and with A and Kr gives shifts to the red; He gives shifts to the blue. All these are greater for higher rotational quantum number (J). With added DCl the direction of shift varies irregularly with J.

G.F.Lothian

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5928 PRESSURE SHIFTING OF SPECTRUM LINES: SOME EMPIRICAL GENERALISATIONS.
D.H.Rank, W.B.Birtley, D.P.Eastman and T.A.Wiggins.
J chem. Phys., Vol. 32, No. 1, 298-9 (Jan., 1960).

Plotting $\Delta\nu/\nu P$, where ν is wave-number and P is pressure of added gas, against polarizability (α) for the R(10) line of HCl (see two preceding abstracts) gives a straight line. Similar plots of shifts for the 21 cm line of H [Anderson, Pipkin and Baird, Bulletin of the American Physical Society, Ser. II, 4, 418 (1959)] and of the 2537 A Hg line (Abstr. 80 of 1924) give similar parallel lines. Broadening is greater when α for the foreign gas is anisotropic.

G.F.Lothian

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5929 THE VIBRATION–ROTATION BAND ν_3 OF HDO VAPOR. N.M.Gailar and F.P.Dickey.
J. molecular spectrosc., Vol. 4, No. 1, 1-15 (Jan., 1960).

This spectrum has been re-measured, and an analysis of the rotational structure carried out. The band centre and the values of the reciprocals of the moments of inertia have been determined: $\nu_0 = 1403.42\ cm^{-1}$, $A(V) = 25.551\ cm^{-1}$, $B(V) = 9.238\ cm^{-1}$, and $C(V) = 6.335\ cm^{-1}$. This band is a hybrid, and the ratio of intensities is approximately Intensity B: Intensity A = 2:1.

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5930 INFRARED DETECTION OF THE FORMYL RADICAL HCO. G.E.Ewing, W.E.Thompson and G.C.Pimentel.
J. chem. Phys., Vol. 32, No. 3, 927-32 (March, 1960).

The photolysis of HI, DI, HBr, and DBr suspended in solid CO at 20°K is described. The formyl radical, HCO or DCO, is produced as shown by broad absorptions in the visible spectral region (6695, 6352, 6052, 5789, 5548, 5330, 5102 A) which correspond to absorptions of gaseous HCO. Infrared absorptions of HCO (at 1860 and 1091 cm^{-1}) and of DCO (at 1860 and 856 cm^{-1}) provide a basis for discussing the chemical bonding of this free radical, and for calculating its thermodynamic properties. These experiments, the first infrared detection of a triatomic free radical by the matrix isolation method, depend upon reactivity of the matrix, possibly eliminating difficulties of the cage effect.

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5931 CHEMICALLY INDUCED VIBRATIONAL EXCITATION : HYDROXYL RADICAL EMISSION IN THE 1-3 MICRON REGION PRODUCED BY THE H + O_3 ATOMIC FLAME.
D.Garvin, H.P.Broida and H.J.Kostkowski.
J. chem. Phys., Vol. 32, No. 3, 880-7 (March, 1960).

A detailed investigation was performed in the 1- to 3-μ wavelength region on the radiation emitted by the hydroxyl radical from a low-pressure flame of ozonized oxygen and atomized hydrogen. Wavelengths and photon intensities were obtained for about 300 lines in the OH vibration-rotation bands V–V–ΔV where ΔV = 3, V = 9 to 5, and for ΔV = 2, V = 9 to 2. Relative photon band intensities were determined from the overdetermined set of data by a method of successive approximations using an I.B.M. 650 computer. Dipole moment parameters were calculated using the above data and Morse oscillator transition probabilities. Approximate rotational and vibrational Boltzmann distributions exist with an average rotational "temperature" of 560°K for the P branches, 460°K for the R and Q

branches, and a vibrational "temperature" of 9250°K for the $\Delta V = 2$ and 3 bands. The absence of radiation from levels $V > 9$ confirms the nonthermal character of the excitation and its dependence on the energetics of the reaction $O_2 + H \rightarrow OH + O_2$. Moreover, flux calculations based on the assumption in this case collisional deactivation transition probabilities are proportional to the radiation probabilities show that there is an appreciable OH production in all levels $V \leq 9$ and the main flux of OH through any population level is via $\Delta V = 1$ transitions. Possible causes for the large changes in line intensity with pressure and smaller but significant changes with flows or concentrations are discussed.

539.19

5932 THE MAGNETIC ROTATION SPECTRUM OF ICl AND IBr. W.H.Eberhardt, Wu-chieh Cheng and H.Renner.

J. molecular Spectrosc., Vol. 3, No. 6, 664-72 (Dec., 1959).

The magnetic rotation spectrum of ICl corresponding to the transition $^3\Pi_1 \leftarrow {}^1\Sigma$ is reported and provides a classic example of the theory of the phenomenon and its application to structure analysis, isotope effects, and the determination of dissociation limits. In the region of vibrational energy in excess of 96% of the dissociation energy an anomalous drop in intensity is observed and explained only qualitatively in terms of an electronic perturbation. IBr exhibits a very similar but much weaker spectrum in the infrared as expected but also shows an unexpected and unusual spectrum in the visible with an anomalous isotope effect in which transitions to only $v' = 25$ for IBr^{81} and $v' = 26$ for IBr^{79} are observed with a separation of approximately 30 cm^{-1}.

539.19

5933 MOLECULAR CONSTANTS OF InCl FROM ABSORPTION BANDS NEAR 3600 ANGSTROMS.

P.Youngner and J.G.Winans.

J. molecular Spectrosc., Vol. 4, No. 1, 23-42 (Jan., 1960).

The absorption spectra of InCl were photographed using 21 ft grating and 8 m of absorbing vapour. The rotational lines of the B(0,0), A(0,0), A(0,1), and A(1,0) bands were identified and their wave numbers determined. An analysis shows that a complete and sensitive test for determining the correct numbering of the rotational lines requires: (a) the equality of the combination differences $\Delta_2 F(J)$ from two or more bands; (b) straight lines on a plot of $\Delta_2 F(J)/(J + \frac{1}{2})$ versus $(J + \frac{1}{2})^2$. Either (a) or (b) alone will not form a complete test. The numbering of the rotational lines in this study satisfied both of these tests. A rotational analysis gave the following values to the rotational constants for system A: $r_e' = 2.333 \times 10^{-8}$ cm, $r_e'' = 2.399 \times 10^{-8}$ cm; $B_e' = 115.5 \times 10^{-3}$ cm^{-1}, $B_e'' = 109.3 \times 10^{-3}$ cm^{-1}; $\alpha_e' = 6.54 \times 10^{-4}$ cm^{-1}, $\alpha_e'' = 5.24 \times 10^{-4}$ cm^{-1}; $D_e' = 6.5 \times 10^{-8}$ cm^{-1}, $D_e'' = 6.3 \times 10^{-8}$ cm^{-1}. These results agree, within the range of experimental error, with the value $r_e = 2.4011 \times 10^{-8}$ cm obtained from a microwave absorption experiment on InCl.

539.19

5934 THE LOW-FREQUENCY VIBRATION ROTATION BANDS OF THE AMMONIA MOLECULE.

J.S.Garing, H.H.Nielsen and K.Narahari Rao.

J. molecular Spectrosc., Vol. 3, No. 5, 496-527 (Oct., 1959).

The absorption spectra from 1440 cm^{-1} to 1840 cm^{-1} and from 510 cm^{-1} to 1280 cm^{-1} have been obtained with a vacuum grating spectrometer. The frequencies of the observed lines are given and the energy levels for the ν_1, ν_3, and $2\nu_2$ vibration–rotation modes computed, A theoretical discussion of the Coriolis interaction between the ν_2 and ν_4 band and the "giant" l-type doubling observed in the ν_4 band is given and the results applied to the observed data.

539.19

5935 INFRARED SPECTRUM AND DIPOLE MOMENT FUNCTION OF LITHIUM HYDRIDE.

T.C.James, W.G.Norris and W.Klemperer.

J. chem. Phys., Vol. 32, No. 3, 728-34 (March, 1960).

Line intensities in the 0-1 and 1-2 rotation-vibration bands of lithium hydride at 7 μ were measured. The ratio of the dipole moment to the dipole derivative is $u_e/(\partial u/\partial r)_{r_e} r_e = 1.8 \pm 0.3$. It is shown that the dipole moment of a diatomic molecule approaches the united atom limit as the third power of the internuclear separation.

539.19

5936 THE TiO-BAND 11032 A.

A.V.Pettersson.

Ark. Fys., Vol. 16, Paper 16, 185-90 (1959).

A rotational analysis of the band 11032.2 A has been carried out. It is the 0–0 band of a $^1\Pi - {}^1\Sigma$ transition, which has the upper state in common with the $^1\Pi - {}^1\Delta$-band at 8860 A.

539.19

5937 FLAME SPECTRA : THE EFFECT OF DEUTERATION ON THE HYDROCARBON FLAME BANDS.

G.N.Spokes and A.G.Gaydon.

Proc. Phys. Soc., Vol. 74, Pt 5, 639-41 (Nov., 1959).

Photographs are shown of the hydrocarbon flame bands from normal, deuterated and partly deuterated acetylene. The isotope displacement shows that the emitter contains one, and only one, hydrogen atom, thus favouring HCO. A vibrational array for DCO is given. A.G.Gaydon

539.19

5938 INFRARED AND RAMAN SPECTRA OF FLUORINATED ETHANES. XII. 1, 1, 2, 2-TETRAFLUOROETHANE.

P.Klaboe and J.R.Nielsen.

J. chem. Phys., Vol. 32, No. 3, 899-907 (March, 1960).

For Pt XI, see Abstr. 6741 (1959). The infrared absorption spectra of gaseous CHF_2-CHF_2 at five temperatures between 30° and 170°C and of the crystalline solid at −170°C were obtained with a Perkin–Elmer double-pass spectrometer equipped with CsBr, CaCl, and LiF prisms. The Raman spectrum of the liquid at 20°, −25°, and −80°C has been photographed with a 3-prism glass spectrograph of reciprocal linear dispersion 15 A/mm at 4358 A, and polarization measurements have been made. In the gaseous and liquid states the compound exists as a mixture of two rotational isomers of symmetries C_{2h} and C_2, respectively, the former (trans) being the more stable. In the crystalline state only the trans configuration is present. A value of 1160 ± 100 cal/mole was found for the enthalpy difference ΔH^0 in the gas. In the liquid ΔH^0 is much smaller. With some uncertainties, the vibrational fundamentals have been assigned for each isomer.

539.19

5939 MECHANISM FOR THE OPTICAL ABSORPTION IN SOME PARAMAGNETIC SALTS. R.Englman.

J. chem. Phys., Vol. 32, No. 1, 299-300 (Jan., 1960).

A theory is proposed to explain absorption in the optical frequency range by octahedrally hydrated paramagnetic ions. Prediction of the intensity of absorption may be made by assuming the charge transfer states of the hydrous complex to be the most effective contaminants; reasonable agreement with experiment is obtained. G.I.W.Llewelyn

539.19

5940 THE OVERLAPPING HYDROGEN FLUORIDE MONOMER–DIMER SPECTRA. D.F.Smith.

J.molecular Spectrosc., Vol. 3, No. 5, 473-85 (Oct., 1959).

It is shown that the data of Kuipers[(J. molecular Spectrosc., Vol. 2, No. 2, 75-98 (April, 1958)] on the absorption of the HF monomer lines can be interpreted if the line contour is expressed in a modified Lorentz form

$$\alpha = \alpha_e a^2 p^2 [(\nu - \nu_0)^{1.5} + a^2 p^2]^{-1}.$$

The apparent absorbance at the line centres has been measured under such circumstances that the temperature variation of $\alpha_e a^2$ can be obtained. It is shown that the line breadth parameter, a, has the temperature variation expected if resonant dipole intermolecular forces are for the most part responsible for the line breadth. The absorption computed from the modified Lorentz expression between the monomer lines is sometimes considerably less than the absorption that is measured. The difference is attributed to HF dimer. There result three dimer bands. The strongest is broad and featureless with a peak near 3857 cm^{-1}, the two other bands have PQR structures with Q branch peaks at 3895 and 3965 cm^{-1}. The temperature dependence of the dimer absorption indicates a heat of decomposition of about 6 kcal/mole.

539.19

5941 THE SPECTRUM OF IRON MONOCHLORIDE IN THE VISIBLE. S.P.Reddy and P.Tiruvenganna Rao.

J. molecular Spectrosc., Vol. 4, No. 1, 16-22 (Jan., 1960).

The spectrum of FeCl excited both in high-frequency and heavy-current discharges, reveals the existence of four discrete band systems in the region λλ4690-6560. Extending Müller's designation of the two near untraviolet systems of FeCl, these were designated as systems, III, IV, V, and VI starting from the violet end. Of these, system III consists of four marked sequences of red degraded bands.

The structure of this band system was observed to be complex. The strong $\Delta v = 0$ and $+1$ sequences were photographed using the second order of a 21 ft concave grating spectrograph. The observed structure of the bands was interpreted on the basis of a $^4\Pi_{a,b} - {}^4\Sigma$ transition, the lower $^4\Sigma$ state being common to system II of FeCl. The vibrational analyses of systems IV, V, and VI which consist of single-headed bands have also been carried out and the constants derived. Each of systems V and VI corresponds to transitions between two excited states of the FeCl molecule.

539.19 : 539.18

5942 EXCITATION OF N_2 AND O_2 BY 1/2 AND 1 MeV PROTONS.
R.W.Nicholls, E.M.Reeves and D.A.Bromley.
Proc. Phys. Soc., Vol. 74, Pt 1, 87-91 (July 1, 1959).

Spectroscopic observations have been made photographically, over the wavelength range from 3800-8000 A, upon the luminosity produced by 0.5 and 1 MeV proton beams in N_2, over the pressure range 63 μ Hg to atmospheric, and in O_2 at atmospheric pressure. The spectra excited in N_2 consisted entirely of bands of the N_2 First Positive ($B^3\Pi - A^3\Sigma$) and Second Positive ($C^3\Pi - B^3\Pi$) systems, and of the N_2^+ First Negative ($B^2\Sigma - X^2\Sigma$) system. No atomic lines of H I, N I, or N II were found. In contrast, the spectra excited in O_2 consisted solely of lines of O I and O II. No bands of O_2 or O_2^+ were found. The probable excitation mechanisms of these spectral features are discussed.

539.19

5943 FURTHER BANDS IN THE γ, ϵ AND β BAND SYSTEMS OF THE MOLECULAR SPECTRUM OF NITRIC OXIDE.
I.Deézsi and T.Mátrai.
Acta phys. Hungar., Vol. 7, No. 1, 111-16 (1957).

Six γ, two ϵ, and two β bands of the NO molecule were photographed in a Geissler discharge produced at reduced pressure. These assignments are: (3,6), (0,7), (3,12), (2,11), (1,10), and (2.13) γ bands; (2,9) and (2,8) ϵ bands; (5,4) and (2,11) β bands.

539.19

5944 THE BAND SPECTRA OF NiCl AND NiBr IN THE VISIBLE. S.Paddi Reddy and P.Tiruvenganna Rao.
Proc. Phys. Soc., Vol. 75, Pt 2, 275-9 (Feb., 1960).

The emission spectra of NiCl and NiBr in the region λ 3900-4800 A (excited in discharges) have been photographed under high dispersion. The spectrum of NiCl consists of nine separate brief systems of bands while the NiBr spectrum consists of six systems of bands. The observed bromine isotope effect in three of the band systems of the NiBr molecule confirms the vibrational analyses. Tables of vibrational constants of the different band systems of each molecule are presented.

539.19

5945 THE ABSORPTION SPECTRUM OF SOLID α-OXYGEN. E.M.Hörl.
J. molecular Spectrosc., Vol. 3, No. 5, 548-53 (Oct., 1959).

Absorption spectra of solid α-oxygen in the range between 2300 and 8800 A were observed near liquid helium temperature. A new system of broad and diffuse bands was detected between 2400 and 2700 A which is believed to be related to the Herzberg system ($A^3\Sigma_u^+ \leftrightarrow X^3\Sigma_g^-$) of O_2 in the gas phase. Also, the bands in the visible region previously described by Prikhotko and co-workers were observed. Electron bombardment of solid α-oxygen changed the absorsorption spectrum in the ultraviolet region causing strong absorption below 3100 A, presumably caused by O_3.

539.19

5946 EMISSION OF DIFFUSE BANDS OF SODIUM BEHIND SHOCK FRONTS. H.Takeyama and A.Guttman.
J. chem. Phys. Vol. 32, No. 2, 634-5 (Feb., 1960).

A trace is shown of the spectrum of a powdered sodium salt excited by a reflected shock through argon. With large amounts of salt the D lines are accompanied by the red and green Na doublets and by a continuum 5490-6200 A. This is associated with the broadened D lines and attributed to incipient (van der Waals) molecules of Na_2.
A.G.Gaydon

539.19

5947 AN EMISSION SYSTEM OF THE IO MOLECULE. R.A.Durie, F.Legay and D.A.Ramsay.
Canad. J. Phys., Vol. 38, No. 3, 444-52 (March, 1960).

The "methyl iodide flame bands", lying in the region 4100 to 6300 A, have been photographed using a 21 ft concave grating spectrograph. The bands are shown to arise from an $A^3\Pi \rightarrow X^3\Pi$ transition of the IO molecule. Rotational and vibrational analysis of the bands has been carried out and the molecular constants of IO obtained.

539.19

5948 ORIGIN OF SOME DIFFERENCES IN THE RAMAN SPECTRA OF ACETAMIDE AND n-PHENYLENEDIAMINE IN VARIOUS PHASE STATES. Sh.Sh.Raskin and A.V.Sechkarev.
Dokl. Akad. Nauk SSSR, Vol. 128, No. 1, 67-70 (1959). In Russian.

The spectra were studied in the liquid and crystalline phase (two polymorphous phases in the case of acetamide). For the stable α-modification of acetamide the H bonds link the adjacent molecules in the lattice without forming local complexes, whereas in the case of the labile β-modification the number of molecules in the elementary cell is very large, thus furthering association and complex formation. The analysis of Raman lines obtained for acetamide and n-phenylenediamine seems to bear out that association is the major factor responsible for the changes observed in the Raman spectra on transition from one phase to another.
F.Lachman

539.19 : 532.7 : 535.37

5949 ABSORPTION AND PHOSPHORESCENCE SPECTRA OF THE MONO- AND DI-AZANAPHTHALENES. $\pi-\pi$ PHOSPHORESCENCE AFTER $n-\pi$ ABSORPTION IN DI-AZANAPHTHALENES. R.Müller and F.Dörr.
Z. Elektrochem., Vol. 63, No. 9-10, 1150-6 (1959). In German.

Absorption spectra of quinoline, quinoxaline, and related compounds were measured at room temperature in heptane, ethanol, and acid aqueous solutions. The phosphorescence was measured in ethanol at 100°K. Compounds with two cyclic N atoms show an $n-\pi$ absorption band, but excitation in this produces the same $\pi-\pi$ phosphorescence as in naphthalene. It is suggested that in the nonradiative transition from excited singlet to triplet state an sp^2 orbit of N is filled by a π-electron which is itself replaced by the excited electron.
S.T.Henderson

539.19

5950 THE EFFECT OF TEMPERATURE ON ULTRAVIOLET ABSORPTION SPECTRA AND ITS RELATION TO HYDROGEN BONDING. M.Ito.
J. molecular Spectrosc., Vol. 4, No. 2, 106-24 (Feb., 1960).

The temperature effect on the absorption spectra of several compounds was studied over a wide range of temperature. It was found that all the absorption spectra characterized by $\pi-\pi^*$ transition exhibit a large red shift and an increase in total absorption intensity with decreasing temperature when hydrogen bonds are formed between the solute and solvent molecules. The substances which showed this type of temperature effect were phenol, aniline, and diphenylamine. The absorption band of acetone at 280 mμ, which is characterized by $n-\pi^*$ transition, showed a different temperature effect. Its total absorption intensity decreased progressively with decreasing temperature even when no special interaction existed between acetone and solvent molecules. When hydrogen bonds were formed between these molecules, a blue shift in the absorption maximum is observed in addition to a decrease in the total absorption intensity. The effect of temperature was also studied studied on the $n-\pi^*$ absorption spectra of pyrazine and crotonaldehyde.

539.19

5951 ULTRAVIOLET RESONANCE SPECTRUM OF THE IODINE MOLECULE. R.D.Verma.
J. chem. Phys., Vol. 32, No. 3, 738-49 (March, 1960).

The ultraviolet resonance spectrum of I_2 observed in electric discharges in the region 1830-2370 A was photographed at high resolution with a 21 ft vacuum grating spectrograph, and a thorough and complete analysis of the data in this region is given. The five doublet resonance series are shown to be excited from five rotational levels of vibrational level $v'' = 0$ of the ground state of I_2 to three vibrational levels ($v_{n'}$, $v_{n+e'}$, $v_{n+f'}$) of an upper electronic state by a single iodine atomic line 1830.4 A. The rotational constants for the ground state of I_2 may be represented:

$$B_v = 0.03734 - 0.0001208\,(v + \tfrac{1}{2}) + 0.444 \times 10^{-6}(v + \tfrac{1}{2})^2 - -1.839 \times 10^{-8}(v + \tfrac{1}{2})^3 - 0.057 \times 10^{-10}(v + \tfrac{1}{2})^4 \quad (1)$$

$$D_v = 1.99 \times 10^{-8} + 1.236 \times 10^{-10}(v + \tfrac{1}{2}). \quad (2)$$

The ground-state $\Delta G(v + \frac{1}{2})$ values were obtained from $v'' = 0$ up to the dissociation limit.. A precise value of the dissociation energy

of I_2, has been found to be 12 452.5 ± 1.5 cm^{-1} as against the previous value of 12 439 ± 8 cm^{-1}. The potential energy curve of $X\,^1\Sigma_g^+$ was computed by using the Rydberg–Klein–Rees method after modifying its final expressions, right up to the dissociation limit, and certain curious features in the neighbourhood of the dissociation limit are pointed out. The curve follows the van der Waals force law c/r^6 between r = 4.6 A and r = 6.4 A with $c = 3.7 \times 10^6$. Various possibilities for the nature of the upper electronic state are discussed.

539.19

5952 THEORETICAL CALCULATIONS OF TRANSITION PROBABILITIES IN THE FIRST NEGATIVE ($b^4\Sigma_g^- \rightarrow a^4\Pi_u$) BANDS OF O_2^+. P.S.Rao and J.D.Ranade.
Indian J. Phys., Vol. 31, No. 10, 491-6 (Oct., 1957)

Transition moments and transition probabilities have been calculated using the methods of Manneback (Abstr. 2017 of 1951), Manneback and Rahman (Abstr. 10944 of 1954), for the first negative ($b^4\Sigma_g^- \rightarrow a^4\pi_u$) bands of O_2^+, as some of the bands of this system have been identified in the spectrum of aurorae recently. Results are compared with those of Jarmin, Fraser and Nicholls (Abstr. 8122 of 1955).

539.19

5953 MEASURED TRANSITION PROBABILITIES FOR THE SCHUMANN–RUNGE SYSTEM OF OXYGEN.
C.E.Treanor and W.H.Wurster.
J. chem. Phys., Vol. 32, No. 3, 758-66 (March, 1960).

Transition probabilities were measured in absorption in the wavelength region 2650-3900 A. Oxygen was heated in a shock tube to temperatures up to 4500°K, thereby populating high vibrational and rotational levels. Absorption spectra were photographed using a high-speed flash lamp and a large Littrow quartz spectrograph. Transition probabilities for the bands of three sequences, associated with the zero, 1st, and 2nd vibrational levels of the excited electronic state, yield an f value of 0.048 ± 0.008 which, when corrected for wavelength dependence, is about ¼ that determined in the vacuum ultraviolet. This corresponds to a decrease in transition probability with increasing internuclear separation. Line-width variations with temperature and density have also been measured. The optical diameter for O_2–O_2 collisions was determined as 6 A and for O_2–O collisions as 10 A.

539.19 : 551.5

5954 THE ULTRAVIOLET SPECTRUM OF THE OXYGEN AFTERGLOW AND THE NIGHT AIRGLOW.
C.A.Barth and J.Kaplan.
J. molecular Spectrosc., Vol. 3, No. 6, 583-7 (Dec., 1959).

The spectrum of the oxygen afterglow has been obtained between 3350 and 4500 A with sufficient resolution to resolve the rotational structure of the Herzberg oxygen bands. Six unknown spectral features are present which cannot be identified with the postulated Broida–Gaydon oxygen bands. The vibrational intensity distribution of the Herzberg bands of the oxygen afterglow is compared with their distribution in the night airglow. Several of the unknown afterglow emissions appear to be able to be identified with unknown night airglow emission features. These unknown bands must come from some molecule other than oxygen.

539.19

5955 NEW EMISSION BANDS OF FORBIDDEN SYSTEMS OF NITROGEN IN THE VACUUM ULTRAVIOLET REGION.
M.Ogawa and Y.Tanaka.
J. chem. Phys., Vol. 32, No. 3, 754-7 (March, 1960).

Using a 2 m vacuum spectrograph and an ordinary transformer discharge through mixtures of N_2 with argon and xenon, two new systems of N_2 emission bands were observed, one for each mixture, in the region between 1550 and 2250 A. According to the vibrational analysis, the bands, which were excited in the mixture of (N_2 + A), are due to transition ($a'\,^1\Sigma_u^- - X\,^1\Sigma_g^+$), and the bands, which were excited in the mixture of (N_2 + Xe), are due to the transition ($^3\Sigma_u^- - X\,^1\Sigma_g^+$). The present results are in good agreement with those of Wilkinson and Mulliken whose observations were made for the same systems of bands in absorption.

539.19

5956 ANALYSIS OF THE NEAR ULTRAVIOLET ABSORPTION SPECTRA OF α- AND β-FLUORONAPHTHALENES.
S.Ramamurty, M.Jagannadha Rao and V.Ramakrishna Rao.
Indian J. Phys., Vol. 31, No. 10, 497-510 (Oct., 1957).

The near ultraviolet absorption spectra of α- and β-fluoronaphthalenes were found to consist of two systems: one in the region 3100-2900 A and another in the region 2800-2500 A. The first systems were analysed on the basis of five and four upper state fundamentals in α- and β-fluoronaphthalenes respectively and two lower state fundamentals in β-fluoronaphthalene. Only one upper state fundamental could be found in System II. Both the systems correspond to allowed transitions of the type $^1A' - ^1A'$.

539.19 : 551.5

A STUDY OF THE ABSORPTION FREQUENCIES OF NEGATIVE MOLECULAR OXYGEN IONS IN THE FREQUENCY RANGE 3 TO 44 Mc/s. See Abstr. 4795

539.19

5957 PREDICTED ELECTRONIC SHIFTS IN FLUORINATED NAPHTHALENES. S.Ramamurty.
Indian J. Phys., Vol. 32, No. 12, 584 (Dec., 1958).

539.19

5958 d AND f ELECTRONS IN COMPLEXES OF THE TRANSITION ELEMENTS. C.K.Jörgensen.
J.Chim. phys., Vol. 56, No. 11-12, 889-96 (Nov.-Dec., 1959).
In French.

Review of the similarities and differences between atomic spectra and the absorption spectra of complexes formed by transition elements, and of the description of the properties of these complexes in terms of the ligand field theory. J.Hawgood

539.19

5959 LOWER EXCITED ELECTRONIC STATES OF CARBON MONOXIDE. P.Merryman, C.M.Moser and R.K.Nesbet.
J. chem. Phys., Vol. 32, No. 2, 631-2 (Feb., 1960).

Presents results of SCF–LCAO–MO calculations of the energies of the states $^1\Sigma^+$, $^3\Sigma^+$, $^3\Pi$, $^3\Sigma^-$, $^1\Pi$, at eleven internuclear distances 1.5(0.5)4.0 atomic units. One exponent was used per AO and all integrals were calculated by a uniform procedure. The four excited states are all calculated to have well defined minima at internuclear distances larger than the equilibrium distance (in agreement with experiment), but more sophisticated calculations are required to give sufficiently accurate energies. The whole calculation was automatic. J.Hawgood

539.19

5960 LOW EXCITED STATES IN C_2.
E.Clementi and K.S.Pitzer.
J. chem. Phys., Vol. 32, No. 3, 656-62 (March, 1960).

The energies of the low electronic states of the C_2 molecule are calculated, using a semi-empirical approach. In the calculation, the two-centre core integrals, and the one-centre Coulomb integral, are empirical parameters which are obtained by fitting of the Morse potential curves and from atomic data, respectively. The standard ASMO–LCAO state wave-functions are expanded in covalent, single ionic, and double ionic components, which are constructed so as to obey the Wigner–Wittmer dissociation rules at infinite internuclear distances. The contributions for each component of the expanded state wave-functions are obtained by the variational method. The states considered are $^1\Sigma_g^+$ state of the $\pi_u(4)$ configuration (of 2p orbitals), the $^3\Pi_u$ and $^1\Pi_u$ states of the $\pi_u(3)\sigma_g(1)$ configuration, and the $^3\Sigma_g^-$, $^1\Delta_g$, $^1\Sigma_g^+$ states of the $\pi_u(2)\sigma_g(2)$ configuration. The calculated energies of the $^1\Sigma_g^+$ and $^1\Pi_u$ electronic states agree well with experiment. Finally, a critical analysis is given of the coefficients of the expansion in covalent and ionic structures.

539.19

5961 THE GROUND STATE OF THE HYDROGEN MOLECULE ON THE BASIS OF THE RELATIVISTIC QUANTUM MECHANICS WITH THE AID OF THE WANG WAVE FUNCTION. I. BREIT EQUATION OF THE HYDROGEN MOLECULE. CALCULATION OF THE RELATIVISTIC CORRECTION TERMS OF THE KINETIC ENERGY. J.Ladik.
Acta phys. Hungar., Vol. 10, No. 3, 271-90 (1959).

539.19

5962 UNITED ATOM MODEL OF THE H_2^+ MOLECULE-ION R.Gáspár.
Acta phys. Hungar., Vol. 7, No. 1, 151-9 (1957).

The energy and eigenfunction of the ground state are determined. The eigenfunctions used are the 1s, 2s, 3s, 3d and 5g eigenfunctions of the united atom. The best dissociation energy value obtained by this method is $0.082_4\, e^2/a_0$. Comparing this with the experimental value $0.1\, e^2/a_0$, it can be seen that the calculated dissociation energy converges relatively slowly towards the experimental value.

539.19

5963 UNITED ATOM TREATMENT OF THE H_2 MOLECULE. R.Gáspár.
Acta phys. Hungar., Vol. 7, No. 4, 447-54 (1957).

The eigenfunction of the H_2 molecule is set up with the aid of eigenfunctions of the united atom and determined by the variational method. The matrix components of the energy operator can be obtained with the aid of the matrix components of the one-electron problem and the electron–electron interaction operator. The related analytical calculations can be carried out very easily. From this approximation, the dissociation energy is found to be 3.6 eV. The possibility of taking into account the electron–electron correlation is also investigated in detail.

539.19

5964 UNITED ATOM MODEL OF THE HYDRID MOLECULES HO, HO^- AND H_2O. R.Gáspár and I. Tamássy-Lentei.
Acta phys. Hungar., Vol. 10, No. 2, 149-55 (1959).

In the united atom approximation, the wave-function of the molecule is built up of one-centre one-electron eigenfunctions by the Slater method. This calculations is extended to HO, HO^- and H_2O molecules The values obtained by the present variational method for the energy, equilibrium nuclear separation and dissociation energy are in good agreement with experimental results.

539.19

5965 THE ROLE OF THE SPIN–SPIN INTERACTION IN THE MULTIPLET SPLITTING OF THE $^4\Pi$ STATE OF THE O_2^+ MOLECULE. I.Kovács.
Acta phys. Hungar., Vol. 10, No. 3, 255-8 (1959).

It is shown that the spin–spin interaction causes just the same deviations from the usual multiplet splitting of the $^4\Pi_u$ state, as does the spin–orbit interaction, by which the deviations were originally explained. Thus the deviations originate simultaneously from both interactions.

539.19

5966 SEMIEMPIRICAL CALCULATION ON THE ELECTRONIC STRUCTURE OF THE NITROGEN-CONTAINING HETEROCYCLIC MOLECULES. III. LOWER TRIPLET LEVELS OF PYRAZINE. T.Anno and A Sadô.
J. chem. Phys., Vol. 32, No. 2, 619-20 (Feb., 1960).

The semiempirical theory of Pts I and II (Abstr. 1828-9 of 1959) is used to calculate the triplet levels of pyrazine. The theoretical calculation is consistent with experimental indications that the lowest triplet level is of n-π type. The theoretical value of 3.09 eV for the $^3B_{1u}$ and $^3B_{2g}$ levels (which are in accidental degeneracy) compares well with the observed value of 3.22 eV.
W.J.Orville-Thomas

539.19

5967 SEMIEMPIRICAL CALCULATION ON THE ELECTRONIC STRUCTURE OF THE NITROGEN-CONTAINING HETEROCYCLIC MOLECULES. IV. ELECTRONIC STRUCTURE OF PYRIDINE. T.Anno.
J. chem. Phys., Vol. 32, No. 3, 867-71 (March, 1960).

For Pt II, see Abstr. 1829 (1959). The semiempirical theory proposed in Pt I is applied to pyridine. Only the singlet levels are considered in this paper, deferring the discussions on the triplet levels to a later publication. Doubly excited as well as singly excited configurations are taken into CI calculation. The hybridization parameter λ of the nitrogen nonbonding AO determined so that the calculated value of the lowest singlet-singlet n–π transition energy agrees with the experimental value is +0.5439 which corresponds to 22% s character of the nitrogen nonbonding AO. By assuming this value of λ, the lower singlet levels of this molecule are calculated and compared with experiment. The calculation shows that a hidden n–π transition ($^1A_2$–$^1A_1$ transition) exists in the neighbourhood of the strong 4.8 eV band which is assigned to a π–π transition.

539.19

5968 CARBON-13 HYPERFINE SPLITTING IN $CH(COOH)_2$. H.M.McConnell and R.W.Fessenden.
J. chem. Phys., Vol. 31, No. 6, 1688-9 (Dec., 1959).

An interpretation of the observed C^{13} hyperfine structure splitting in the e.s.r. of X-irradiated malonic acid is presented which requires positive spin density at the C^{13} nucleus. This is the theoretically expected sign of the spin density. J.M.Baker

539.19

5969 ON THE ELECTRON SPIN RESONANCE SPECTRA OF HYDROCARBON RADICALS. P.G.Lykos.
J. chem. Phys., Vol. 32, No. 2, 625-6 (Feb., 1960).

The hyperfine splittings due to protons in the spectra of cyclohexane and cyclopentane radicals are calculated using a model consisting of two non-rotating methylene groups sigma-bonded to a carbon atom in an $sp^3\pi$ valence state, and the splittings compared with the known experimental values. E.F.W.Seymour

539.19

5970 PROTON RELAXATION TIMES IN PROTEIN COMPLEXES OF PARAMAGNETIC IONS. A.Wishnia.
J. chem. Phys., Vol. 32, No. 3, 871-5 (March, 1960).

Proton longitudinal relaxation times in dilute solutions of Fe^{3+}, iron conalbumin (FeCon), and ferrihaemoglobin (Hb^+), were measured at 40 and 60 Mc/s. The static magnetic moment is 5.9 Bohr magnetons for all three species; the ratios of $1/NT_1$ for Fe^{3+}, FeCon, and Hb^+ are 1 : 0.72 : 0.026. For the proteins the relevant correlation time τ_C in Solomon's expression for the dipolar contribution to T_1 is the electron spin relaxation time τ_S of the paramagnetic ion, which for FeCon is 3×10^{-11} sec. τ_S may contribute to τ_C in other complexes of Fe^{3+} and Cr^{3+}. A simple model for Hb^+ shows the heme Fe to be 4 A from the surface of the protein.

539.19 : 538.27 : 532.7

PROTON MAGNETIC RESONANCE IN ISO-BUTYL BROMIDE.
See Abstr. 5039

539.19

5971 THE SCALE PARAMETERS IN NON-EMPIRICAL MOLECULAR-ORBITAL CALCULATIONS ON σ– π SYSTEMS. E.T.Stewart.
Proc. Phys. Soc., Vol. 75, Pt 2, 220-7 (Feb., 1960).

Parr and Crawford's calculations (Abstr. 3408 of 1948) on the ethylene molecule have been extended so as to constitute a systematic study of the dependence of calculated π-electron excitation energies on the exponential scale parameter Z. An examination of the results and their wave-mechanical basis leads to the following conclusions: (i) In the neighbourhood of $Z_\sigma = Z_\pi = 3.18$ both state energies and excitation energies are so sensitive to small changes in Z that they can have little quantitative meaning. (ii) Joint variation of Z_σ and Z_π between different π-electron states is admissible, and provided its consequences are not masked by the use of the W_{zp} approximation, it can easily give transition energies incorrect even in sign. (iii) If Z_σ is kept constant, the independent variation of Z_π yields results which, though they have the partial validity characteristic of a partial-variation calculation, are not necessarily numerically significant: the "optimum" values of Z_π for the various π-electron states and the corresponding "minimum" energies almost certainly vary considerably with the form of the σ wave-function and with the value of Z_σ. (iv) The establishment of a sound parametric basis for computations on systems described by π-electron wave-functions is unlikely to result from anything less comprehensive than a 6-centre–16-electron variational study on ethylene. Until this can be achieved, non-empirical calculations on unsaturated hydrocarbon molecules seem bound to be ineffectual.

539.19

5972 SOME CALCULATIONS BASED ON AN LCGO-MO TREATMENT. J.Higuchi.
J. chem. Phys., Vol. 32, No. 2, 636-7 (Feb., 1960).

MO calculations based on dividing molecules into groups [e.g. ethane is treated as a two (methyl) group system] are described for C_2H_6, C_3H_6, and the C_3H_5 radical. This is accomplished by using as units in the general molecular orbital group orbitals which are approximately united-atom orbitals with one centre. Fair agreement is obtained between calculated and observed values for ionization energies, e.g., for ethane the values are 12.57 eV (calc.), 11.63 eV (obs.). The abbreviated description LCGO-MO (GO = Group Orbital) is suggested for this method. W.J.Orville-Thomas

539.19

5973 CONFIGURATIONAL INTERACTION IN MOLECULAR ORBITAL THEORY AS APPLIED TO INDENE. S.Ramamurty.
Indian J. Phys., Vol. 32, No. 12, 582-3 (Dec., 1958).

539.19

5974 THE USE OF ONE-CENTER ATOMIC ORBITALS FOR THE BUILDING UP OF HYDROGEN ORBITALS IN A TETRAHEDRAL SYMMETRIC HYDRID MOLECULE. E.Kapuy.
Acta phys. Hungar., Vol. 10, No. 2, 241-7 (1959).

Slater orbitals are applied to the construction of a trial wave-function of the 1s ground state of a H atom, being at a distance of 2 A

from the midpoint. If the angular component is a combination of the orbitals s, p corresponding to a sp^3 hybrid enlarging the radial component $re^{-\gamma r}$ by further terms $r^{n-1}e^{-\gamma r}$, negligible improvement appears in the energy (about 0.01 A). Combining the simple radial component $re^{-\gamma r}$ with its angular component p, d, f, an improvement of about 0.14 A may be achieved in the energy.

539.19

5975 PI–SIGMA INTERACTION IN THE FREE-ELECTRON MODEL. I. THEORY. S.Olszewski.
Acta phys. Polon., Vol. 16, No. 5, 369-79 (1957).

The method of antisymmetrized molecular orbitals for the three-dimensional free-electron model is developed for the case of linear conjugated molecules. In this model the π and σ electrons are assumed to form a gas in a cylindrical box extending along the molecular core, and both groups of electrons are characterized according to the classification given originally by Nikitine and Komoss (1954). Then the whole $\pi - \sigma$ interaction can be treated directly, contrary to the treatment of this problem in the Goeppert–Mayer–Sklar scheme. The values of the electronic repulsion integrals, presented previously for the case of the so called "one dimensional" free-electron model (Abstr. 6824 of 1956) were verified as corresponding to the integrals of the present scheme when the radius of the box tends to zero.

539.19

5976 ELECTRON-POPULATION ANALYSIS AND THE DIPOLE MOMENT OF THE LiH $^1\Sigma^+$ EXCITED STATE. A.M.Karo.
J. chem. Phys., Vol. 32, No. 3, 907-13 (March, 1960).

Detailed consideration is given to some properties of the first excited electronic state. Following the analysis proposed by Mulliken, SCF LCAO-MO coefficients are used to obtain qualitative information about the electron distribution. Comparison is made with earlier work with respect to the description of the excited state in terms of the interacting configurations. In addition to the excited-state dipole moment, the effective electric moment between the ground and excited states is also calculated. From this, the oscillator strength for the first allowed transition is computed as a function of the internuclear distance.

539.19

5977 CONSTRUCTION OF HYBRID ORBITALS. J.N.Murrell.
J. chem. Phys., Vol. 32, No. 3, 767-70 (March, 1960).

A method is given for constructing the best hybrid orbitals for a molecule $M-(X_1 \ldots X_k)$ from a set of n atomic orbitals of M, based on the principle of maximum overlap. To illustrate the theory, hybrid orbitals for ClF_3 are constructed from the chlorine 3s, 3p, and 3d atomic orbitals.

539.19

5978 BOND AND MOLECULAR POLARIZABILITY TENSORS. I. MATHEMATICAL TREATMENT OF BOND TENSOR ADDITIVITY. R.P.Smith and E.M.Mortensen.
J. chem. Phys., Vol. 32, No. 2, 502-7 (Feb., 1960).

A general equation is obtained for the polarizability tensor of a molecule, considering the molecular tensor to be constructed from bond tensors. Bond-by-bond transformations of the bond tensors are used, so that the general equation involves bond angles and angles describing internal rotations. For tetrahedral hydrocarbons and their derivatives, the general equation reduces to simple forms. It is shown that the theory provides a simple method for the calculation of molecular anisotropy.

539.19

5979 BOND AND MOLECULAR POLARIZABILITY TENSORS. II. DISCUSSION OF VALUES OF POLARIZABILITY PARAMETERS FOR SOME SINGLE BOND INVOLVING CARBON. R.P.Smith and E.M.Mortensen.
J. chem. Phys., Vol. 32, No. 2, 508-11 (Feb., 1960).

It is pointed out that for C–C, C–H, C–O, and C–halogen bonds, the experimental data on molecular polarizability tensors (light depolarization data, Kerr constants, etc.) do not permit evaluation of longitudinal and transverse bond polarizabilities. Only certain linear combinations of these quantities, involving parameters for more than one type of bond, are determinable. The data pertaining to these bonds are discussed in this light. Denbigh's longitudinal and transverse polarizabilities for C–halogen bonds probably are essentially correct, but his C–C and C–H polarizabilities are not meaningful.

539.19

5980 A BOND-ORDER/BOND-LENGTH RELATION FOR OXYGEN–OXYGEN BONDS. W.J.Orville-Thomas.
J. molecular Spectrosc., Vol. 3, No. 6, 588-91 (Dec., 1959).

A relation based on molecular orbital theory is proposed.

539.19

5981 A THEORETICAL INVESTIGATION OF THE ROLE OF POLARIZATION IN THE FORMATION OF HYDROGEN BONDS. R.Grahn.
Ark. Fys., Vol. 15, Paper 23, 257-78 (1959).

Investigates whether polarization energies ought to be taken into account when calculating hydrogen bond energies. Therefore the aim has been to get only the correct orders of magnitude, and not quantitative information, concerning these energies. The corresponding elastrostatic energies have, for comparison, been estimated by means of rough models. In two of the cases investigated, H_2O and HF, the molecules of which form strong H bonds, the polarization energies were found to be of the same orders of magnitude as the total H bond energy. For H_2S and HCl, the molecules of which form no, or very weak, H bonds, the polarization energies were found to be negligible compared with the energy of a normal H bond.

539.19

5982 POTENTIAL ENERGY CURVES OF HYDROGEN FLUORIDE.
R.J.Fallon, J.T.Vanderslice and E.A.Mason.
J. chem. Phys., Vol. 32, No. 3, 698-700 (March, 1960).

Potential energy curves for the $X^1\Sigma^+$ and $V^1\Sigma^+$ states of HF and DF are calculated by the Rydberg–Klein–Rees method. The results calculated from the different sets of data for HF and DF are found to be in very good agreement. The theoretical results of Karo are compared to the experimental results obtained here.

539.19

5983 STRUCTURE OF WATER. G.W.Brady and W.J.Romanow.
J. chem. Phys., Vol. 32, No. 1, 306 (Jan., 1960).

Results of an X-ray diffraction study confirm the data of Morgan and Warren (Abstr. 4763 of 1938) which suggested a quasi-tetrahedral structure to the H_2O molecule. An attempt is made to explain the different results obtained by van Panthaleon et al [Disc. Faraday Soc., Vol. 24, 200 (1957)]. G.I.W.Llewelyn

539.19

5984 NOTE ON THE USE OF GROUND-STATE ROTATIONAL CONSTANTS IN THE DETERMINATION OF MOLECULAR STRUCTURES. L.Pierce.
J. molecular Spectrosc., Vol. 3, No. 5, 575-80 (Oct., 1959).

A method, independent of the first moment equations, for locating atoms which lie near the centre of mass of a molecule or near a principal axis is proposed. The method gives excellent results for the central nitrogen atom of N_2O. It is also proposed that extension of the method to all atoms of a molecule may lead to structures which very closely approximate equilibrium structures.

539.19

5985 DIPOLE MOMENTS OF SOME SUBSTITUTED BENZENES AND PYRIDINES. I. FLUOROTOLUENES. C.R.K.Murty.
Indian. J. Phys., Vol. 31, No. 5, 256-60 (May, 1957).

539.19

5986 DIPOLE MOMENTS OF SOME SUBSTITUTED BENZENES AND PYRIDINES. II. META DISUBSTITUTED BENZENES. C.R.K.Murty.
Indian J. Phys., Vol. 32, No. 8, 365-8 (Aug., 1958).

539.19

5987 CALCULATIONS OF THE DIPOLE MOMENTS OF TRISUBSTITUTED BENZENES. — 1, 2, 3-, 1, 2, 4-AND 1, 3, 5-SUBSTITUTIONS. D.V.G.L.Narasimha Rao.
Indian J. Phys., Vol. 32, No. 12, 547-55 (Dec., 1958).

The equations of Frank are used in computing the induced moments. In these equations the dielectric constant of the internuclear space is introduced directly to account for its effect on the induced moments. The equations are applied in the first instance to a few typical molecules for which observed moments are available in the literature.

539.19

5988 MEASUREMENT OF DIPOLE MOMENTS AT MICROWAVE FREQUENCIES. J.E.Boggs and A.P.Deam.
J. chem. Phys., Vol. 32, No. 1, 315-16 (Jan., 1960).

The value of 0.53 D obtained by Magnuson (Abstr. 2854 of 1956) for the dipole moment of 1,2-dichlorotetrafluorethane is corrected to 0.56 D when non-resonant dispersion is taken into account. It is pointed out that for other gases the error caused by ignoring the dispersion can be very much greater. W.J.Orville-Thomas

539.19

5989 STRUCTURE OF ISOBUTYLENE. L.S.Bartell and R.A.Bonham.
J. chem. Phys., Vol. 32, No. 3, 824-6 (March, 1960).

The molecular structure of gaseous isobutylene was investigated by the sector-microphotometer method of electron diffraction. The major internuclear distances found, in terms of centre of gravity parameters, r_g, were C–H (methyl) = 1.113 ± 0.003 A (assumes ethylenic hydrogens have ethylene values), C=C = 1.331 ± 0.003 A, C–C = 1.505 ± 0.003 A, and $(C...C)_{Av}$ = 2.498 ± 0.005 A. Angles were C–C–H (methyl) = 110.4° and Me–C–Me ~ 112°. Amplitudes of vibration were determined.

539.19

5990 EFFECT OF SPECIMEN DELOCALIZATION IN ELECTRON DIFFRACTION STUDIES OF GAS MOLECULES. L.S.Bartell.
J. appl. Phys., Vol. 31, No. 2, 252-4 (Feb., 1960).

The effect upon a normal electron diffraction pattern of an extraneous uniform distribution of the gaseous specimen is considered quantitatively. It is shown that the delocalization of gas may lead to errors in internuclear distances of several thousandths of an Angstrom unit or more in conventional experiments. Equations are presented for the correction of experimental data.

539.19

5991 ELECTRON DIFFRACTION STUDY OF MONOMETHYL- AND DIMETHYLPHOSPHINE. L.S.Bartell.
J. chem. Phys., Vol. 32, No. 3, 832-4 (March, 1960).

The structural parameters of gaseous monomethyl- and dimethylphosphine were determined by the sector-microphotometer method of electron diffraction. Centre of gravity bond distances and standard errors for the two molecules were, respectively: r_{CP} = 1.858 ± 0.003 A and 1.853 ± 0.003 A; r_{CH} = 1.094 ± 0.008 A and 1.097 ± 0.007 A; r_{PH} = 1.423 ± 0.007 A and 1.445 ± 0.02 A. The angles P–C–H were 109.6 ± 1° and 109.8 ± 0.7°. In dimethylphosphine the angle C–P–C was 99.2 ± 0.6°. The methyl groups were found to be in staggered confirmations. The distances and root-mean-square amplitudes of vibration agreed well with the values determined in recent studies of phosphine and trimethylphosphine.

539.19

5992 MOLECULAR STRUCTURE STUDIES ON ALKALI HALIDES IN THE VAPOUR STATE BY ELECTRON DIFFRACTION. P.A.Akischin and N.G.Rambidi.
Z. phys. Chem. (Leipzig), Vol. 213, No. 1-2, 111-28 (1960). In German.

The halides of Li, Na, K, Rb, and Cs were studied in the vapour phase by electron diffraction techniques. The halides were found to exist in the monomeric and dimeric states. Bond lengths were obtained for the monomers which are in general agreement with the more accurate values obtained by microwave techniques. The dimers have a planar parallelogram-like structure with metal–halide–metal angles ranging from 116° in LiCl to 95° in RbCl. From an analysis of the intensities values are obtained for the percentage dimer present, under the experimental conditions, in the monomer ⇌ dimer equilibrium. Values are given for ΔH and K_p. An extensive review of earlier work is given. W.J.Orville-Thomas

539.19

5993 COMPARISON OF EXP-6, L.-J. (12,6) AND SUTHERLAND POTENTIAL FUNCTIONS APPLIED TO THE CALCULATION OF DIFFERENTIAL SCATTERING CROSS SECTIONS. H.U.Hostettler and R.B.Bernstein.
J. chem. Phys., Vol. 31, No. 5, 1422-3 (Nov., 1959).

All three potential functions fit the data of Knauer (1933, 1934) to within the experimental error (see Abstr. 6377 of 1957). J.Hawgood

539.19

5994 AN ESTIMATE OF THE EFFECT OF COLLISIONS OF THE SECOND KIND WITH CO MOLECULES ON THE INTENSITY OF EMISSION OF N_2 BANDS IN A GLOW DISCHARGE. D.N.Radikov.
Optika i Spektrosk, Vol. 4, No. 3, 396-8 (1958). In Russian. English summary: PB 141047T-4 obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

Experiment shows that at low pressures (~mm Hg) the ratio of the intensity of a given band in N_2 in the presence of CO to that of the same band in pure N_2, increases linearly with the ratio R of the partial pressure of CO to that of N_2, for $1 < R < 20$. This result is shown to be in accord with the view that the increase in intensity of the bands in the second positive system of N_2 in the presence of CO is due to the excitation of N_2 molecules in collisions with metastable CO molecules. J.Dutton

539.19

5995 THE TOTAL EFFECTIVE CROSS-SECTION OF THE COLLISION PROCESS BETWEEN POTASSIUM ATOMS AND CHLORINE MOLECULES. H.Gienapp.
Z. Naturforsch., Vol. 14a, No. 12, 1084-5 (Dec., 1959). In German.

This was measured by the crossed molecular beam method. The results lead to the conclusion that in the collision process between K atoms and Cl_2 molecules reaction ($K + Cl_2 \rightarrow KCl + Cl$) sets in at relatively great distance (about 14 A). W.Good

539.19

5996 CHARGE TRANSFER IN MOLECULAR HYDROGEN. T.F.Tuan and E.Gerjuoy.
Phys. Rev., Vol. 117, No. 3, 756-63 (Feb. 1, 1960).

See also Abstr. 5869(1960). The effects of the molecule on electron capture by protons in hydrogen gas were investigated in first Born approximation with different types of electronic wave-functions. It always has been supposed that if the incident proton velocity is large compared to electronic velocities molecular effects may be neglected, and that one may then assume one H_2 molecule is equivalent to two hydrogen atoms for purposes of charge transfer. Instead it appears that charge transfer in H_2 at high energies bears no simple relationship to charge transfer in atomic hydrogen. In particular, among other effects: (i) in the high-energy limit $\frac{1}{2}\sigma_M = 1.2-1.4\sigma_A$; (ii) at lower energies there is important interference between the capture amplitudes from the two atoms in the molecule. It also is found that transitions to ungerade states of H_2^+, although unimportant in the energy range of present experiments, become appreciable at high energies.

539.19

5997 ON THE EFFECTS OF INTRAMOLECULAR VAN DER WAALS FORCES. L.S.Bartell.
J. chem. Phys., Vol. 32, No. 3, 827-31 (March, 1960).

Evidence for the existence of strong nonbonded repulsions between atoms bonded to a given atom is cited. It is observed that bond angles in ethylene derivatives and related molecules can be correlated with a simple "hard sphere" model in which atomic positions are presumed to be governed by the sizes of spherical atoms packed around a given atom. Estimations of the magnitudes of the nonbonded interactions are presented. These indicate that the shortening of carbon–carbon single bonds in unsaturated hydrocarbons may be principally attributable to the relaxation of nonbonded repulsions across digonal or trigonal bonds as compared with tetrahedral bonds. It is suggested that intramolecular van der Waals forces may be even more important than effects of hybridization and conjugation or hyperconjugation in governing bond angles, bond distances, energies of isomerization and hydrogenation, and bending vibrations of molecules.

539.19

5998 PROTON MAGNETIC RESONANCE STUDIES OF SOME SILICONES.
H.Kusumoto, I.J.Lawrenson and H.S.Gutowsky.
J. chem. Phys., Vol. 32, No. 3, 724-7 (March, 1960).

Proton magnetic resonance techniques were used to study the molecular motions occurring in some dimethyl silicones. The substances investigated were cured Silastic 80, 400 Gum, and 200 Fluid (viscosity grade 20 centistokes at 25°C). Measurements were made of the absorption line shape from 77°K to room temperature, and of the spin–lattice relaxation time, T_1, from 160°K to 415°K. Evidence is found for the existence of methyl group reorientation about the triad axis, segmental motions about the Si–O bonds and a form

of intramolecular "spiral" motion of the $(CH_3)_2Si$ groups. The relation of the latter motion to the difference in macroscopic properties of natural and silicone rubbers is discussed.

539.19

5999 UNPERTURBED CHAIN DIMENSIONS OF POLYMERIC CHAINS. C.A.J.Hoeve.

J. chem. Phys., Vol. 32, No. 3, 888-93 (March, 1960).

Methods are given for the calculation of polymer chain dimensions unperturbed by excluded volume effects but dependent on restricted rotation around the chain bonds as a result of interactions between substituents on neighbouring chain atoms. The matrix methods used by most previous investigators are valid only for cases where the rotations, or pairs of neighbouring rotations, are noninteracting. The methods recently developed by Lifson to account for interactions between any two consecutive rotations in chains of the type $(CR_2)_i$ are extended to chains of the type $(CH_2{-}CR_2)_i$ and isotactic chains of the type $(CH_2{-}CHR)_i$. As an illustration the chain dimensions of polyisobutylene are calculated by using parameters from X-ray data in the crystalline state and results from stress–temperature measurements on amorphous networks. Reasonable agreement is obtained with experimental data on dilute solutions of polyisobutylene.

539.19 : 535.56

6000 OPTICAL ROTATION OF ORIENTED HELICES. II. CALCULATION OF THE ROTATORY DISPERSION OF THE ALPHA HELIX. I.Tinoco, Jr. and R.W.Woody.

J. chem. Phys., Vol. 32, No. 2, 461-7 (Feb., 1960).

For Pt 1, see J. Amer. Chem. Soc., Vol. 81, No. 7, 1540, (April 5, 1959). The polarizability theory for the average optical rotation of a molecule is generalized and used to calculate the optical rotation along specific directions in the molecule. The optical rotatory dispersion of polyglycine and polyalanine for light incident parallel and perpendicular to the helical axis has been calculated. The predicted dispersion is consistent with most experiments if a left-handed helix is assumed for polybenzyl-L-glutamate and peptides with similar rotatory behaviour. The average rotatory dispersion for a helix is not in general qualitatively different from that of a random coil.

SOLID-STATE PHYSICS

539.2

6001 THE PHYSICS OF CRYSTALS. C.V.Raman.

Proc. Indian Acad. Sci. A, Vol. 43, No. 6, 327-35 (June, 1956).

Address to a Conference of Nobel Laureates at Lindau, June 25th to 29th, 1956.

539.2

6002 SUMMARIZED PROCEEDINGS OF A CONFERENCE ON SOLID STATE PHYSICS–MELBOURNE, AUGUST 1959. J.F.Nicholas.

Brit. J. appl. Phys., Vol. 11, No. 4, 137-42 (April, 1960).

The Australian Branch of The Institute of Physics held a conference on solid state physics in Melbourne from 17-21 August, 1959. This conference was the first of its kind to be held in Australia and attracted an attendance of about one hundred and thirty. In all, 46 papers, ranging over a wide field, were presented and these are summarized; they include papers on superconductivity, transport properties, surface properties, optics, theoretical physics, magnetism, plastic deformation and crystal imperfections.

539.2

6003 SOLID STATE PHYSICS. W.M.Lomer.

Nature (London), Vol. 184, 1117 (Oct. 10, 1959).

Report of a conference held at Melbourne during Aug. 1959. Papers ranging across the whole field of this subject were presented.

539.2 : 532.7

6004 THE IMPORTANCE OF SYMMETRY IN THE SOLIDS AND LIQUIDS. J.D.Bernal.

Acta phys. Hungar., Vol. 8, No. 3, 269-76 (1958).

Discusses the possibility of generalizing the geometrical structure analysis for both solids and liquids. The analysis of structures can be reduced to the geometrical problem of classifying the neighbourhoods of individual points and to the way these neighbourhoods can be related to one another. For the purpose of structure analysis and model building, the geometrical point of view seems to be quite applicable.

539.2

6005 THE ZERO-POINT ENERGY AND EQUATION OF STATE OF SOLID HELIUM AT THE ABSOLUTE ZERO. I.J.Zucker.

Proc. Phys. Soc., Vol. 73, Pt 6, 965-9 (June, 1959).

The Einstein model of a crystal is modified by the inclusion of quartic terms. The coefficients can be calculated from the interaction energy between two atoms, so no adjustable constant appears. Calculations are made of pressure and "effective Debye temperature" (which is given a precise meaning), as functions of volume. Agreement with experiment is good (discrepancies being comparable with the uncertainties in the interaction function) and is quite definitely better than that of a Debye-type theory with harmonic terms only.

H.N.V.Temperley

539.2

6006 THE MATRIX ELEMENTS OF TENSOR OPERATORS FOR THE ELECTRONIC CONFIGURATIONS. B.R.Judd.

Proc. Phys. Soc., Vol. 74, Pt 3, 330-9 (Sept., 1959).

It is shown that many simple relations exist between various reduced matrix elements of the form $(f^n\, WUSL \,\|\, U^k \,\|\, f^n\, W'U'SL')$, where $W = (w_1w_2w_3)$ and $U = (u_1u_2)$ are irreducible representations of R_7 and G_2 respectively. This is done by using the fact that for $k = 2$, 4 and 6, the components U_q^k of the tensor operators U^k, when multiplied by $\sqrt{(2k+1)}$, transform among themselves as the irreducible representations (200) of R_7 and (20) of G_2. The number of linearly independent sets of matrix elements for a given W and W' is equal to the number of times the identity representation (000) of R_7 occurs in the reduction of the product $(w_1w_2w_3) \times (200) \times \times (w_1'w_2'w_3')$; similarly, the number of times the identity representation (00) of G_2 occurs in the reduction of the product $(u_1u_2) \times (20) \times \times (u_1'u_2')$ determines the number of linearly independent sets of matrix elements that can exist with $U = (u_1u_2)$ and $U' = (u_1'u_2')$. These two numbers, which are denoted by $c(WW'(200))$ and $c(UU'(20))$, are tabulated for all W, W', U and U' which occurs in f^n, and the use of the tables in calculating the splittings induced in the levels of rare earth ions by the surrounding crystal lattice is illustrated with a number of examples.

539.2

6007 SOFT X-RAY EMISSION SPECTROSCOPY OF GRAPHITE AND THE SUGGESTION OF A SUITABLE BRILLOUIN ZONE FOR IT. A.Kumar Dutta.

Indian J. Phys., Vol. 32, No. 8, 397-9 (Aug., 1958).

Lattice Dynamics

539.2

6008 CHARACTERISTIC TEMPERATURE AND THE SPECTRUM OF THERMAL VIBRATIONS OF A LATTICE. A.P.Zvyagina and V.I.Iveronova.

Fiz. tverdogo Tela, Vol. 2, No. 1, 118-21 (Jan., 1960). In Russian.

The characteristic temperature θ_X as measured by X-ray methods from $\bar{u}^2$, the mean square amplitude of thermal vibrations, cannot be taken as an index of the strength of the interatomic interactions in a solid solution as is usually done in experimental work. $\bar{u}^2$ depends not only on the limiting frequency (or the bond strength), but also on the form of the spectrum of the thermal vibrations of the lattice which is determined by such factors as the lattice type, the distribution of the atoms in the lattice (degree of ordering), the ratio of the masses of the components and the differences in the strengths of the bonds between different pairs of atoms. To establish a unique correspondence between a change in θ_X and a change in bond strength is only possible in the simplest cases where the lattice spectra have identical forms, that is, when the lattice type, the degree of ordering,

etc. do not change with changes in the concentration of the solid solution and with its thermal treatment. Analogous considerations are also applicable to the characteristic temperature determined from the variation of thermal capacity with temperature, as the thermal capacity also depends on the whole vibration spectrum and not only on its limiting value. A.L.Mackay

539.2

6009 EQUATIONS FOR MULTI-COMPONENT LATTICE GAS (ONE PARAMETER THEORY). J.Czerwonko.
Acta phys. Polon., Vol. 18, No. 4, 271-8 (1959).

The thermodynamic potential, the mean value of energy, and the mean value of numbers of particles for high and low temperatures are calculated. The method used is the variational method of Bogolyubov with one variational parameter.

539.2 : 534.22

6010 THE LINEAR RELATION BETWEEN THE MATERIAL VELOCITY AND THE SHOCK-WAVE VELOCITY IN A METAL. J.Berger and S.Joigneau.
C.R. Acad. Sci. (Paris), Vol. 249, No. 23, 2506-8 (Dec. 9, 1959). In French.

The entropy change in a solid is small even for an intense shock. The pressure is assumed to be a linear function of temperature, and this, combined with the Grüneisen relation, enables theoretical predictions to be made of the coefficients in the observed linear relation between velocities. The agreement with experiment is reasonable. H.N.V.Temperley

539.2

6011 MAGNETIC-FIELD DEPENDENCE OF THE ULTRASONIC ATTENUATION IN METALS.
M.H.Cohen, M.J.Harrison and W.A.Harrison.
Phys. Rev., Vol. 117, No. 4, 937-52 (Feb. 15, 1960).

A self-consistent, semiclassical treatment is given for the attenuation of a sound wave by a free-electron gas in a positive background which supports the sound wave. Emphasis is placed upon the kinds of magnetic-field dependence which can be found under a wide range of values for the magnetic field, frequency, and mean free path. Applications of the general formalism include propagation parallel and perpendicular to the magnetic field. The special phenomena studied include geometric resonances, cyclotron resonances, and magneto-plasma resonance. A qualitative physical interpretation of the various effects found in the detailed calculations is also presented

539.2 : 534.23

6012 CONTRIBUTION TO THE THEORY OF ABSORPTION OF ULTRASONIC WAVES BY METALS IN A STRONG MAGNETIC FIELD. I. É.A.Kaner.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 212-18 (Jan., 1960). In Russian.

The absorption coefficient α of ultrasonic waves in metals in strong magnetic fields is calculated for $r \ll \lambda \ll l$ (r, l are the characteristic orbital radius and mean free path of electrons, λ is the wavelength of sound in the metal). Closed electron orbits are considered under an arbitrary law of electron dispersion. It is shown that in a strong field the value of α becomes saturated, irrespective of whether $n_1 = n_2$ or $n_1 \neq n_2$. At $kl \perp H$ (k is the wave-vector, H is the magnetic field, n_1, n_2 are the numbers of "electrons" and "holes") the saturation value is $kl \gg 1$ times greater than the value $\alpha = \alpha_0$ at $H = 0$ and in all other cases $\alpha \sim \alpha_0$. Comparison of theory with experiment shows good agreement.

539.2

6013 ELECTRON–PHONON INTERACTIONS. D.M.S.Bagguley.
Nature (London), Vol. 185, 586-7 (Feb. 27, 1960).

Report of a conference held at Oxford in December 1959 under the auspices of the Physical Society. The subject-matter was restricted to those aspects of the interactions which were concerned with "transport phenomena" in metals and semiconductors, e.g. electrical and thermal conductivities and thermoelectric effects. Topics directly related to superconductivity were excluded.

539.2

6014 EXCHANGE AND CORRELATION EFFECTS IN ELECTRON–PHONON SCATTERING IN NORMAL METALS. M.Bailyn.
Phys. Rev., Vol. 117, No. 4, 974-84 (Feb. 15, 1960).

The theory of Bardeen (Abstr. 5069 of 1937; 8948 of 1955) for the electron shielding of the perturbation potential arising from lattice vibrations is extended to cover exchange and correlation effects. The method is to set up a self-consistent set of one-electron equations, and calculate the effect of the perturbation in the charge densities. The exchange term is corrected to conform to the results of the Bohm–Pines theory, but the plasma wave-function is assumed not to be disturbed by the lattice. With this approximate model, a solution to the problem can be obtained. For small-angle scattering, the results do not return to the original Bardeen values. The interaction potential matrix element depends on the initial electron wave vector K as well as on the difference between initial and final state wave vectors. Hence, to use the results an average over K must be made, and an average is made over the Fermi surface. The general effect of the exchange hole is to increase the scattering.

539.2

6015 DYNAMICAL ELECTRON-LATTICE COUPLING IN DISTORTED IONIC CRYSTALS.
H.Stumpf and M.Wagner.
Z. Naturforsch., Vol. 15a, No. 1, 30-46 (Jan., 1960). In German.

Continues previous work in this field (Abstr. 5080 of 1955, 3357 of 1956, 6276, 10242 of 1959, 715 of 1960). General conditions for the dynamical electron-lattice coupling are formulated. The results are applied to a particular case in which only electrons localized at lattice defects receive explicit quantum mechanical description. The coupling constant in the wave function and the energy are evaluated for this case and polarons and F-centres are considered as specific examples. J.W.Leech

539.2

6016 HEAT CAPACITY OF TERBIUM FROM 1.4 to 4.0° KELVIN.
R.M.Stanton, L.D.Jennings and F.H.Spedding.
J. chem. Phys., Vol. 32, No. 2, 630-1 (Feb., 1960).

The results are shown graphically and compared with those of Kurti and Safrata (Abstr. 6929 of 1958). Neither the electronic contribution to the heat capacity nor the Debye temperature can be obtained from the data. The reason for the anomalous rise, obtained at 2.4°K is not understood, but may be due to the presence of oxide. S.Weintroub

539.2

6017 LATTICE DYNAMICS AND HEAT CAPACITY OF INDIUM. L.J.Slutsky and A.Livingston.
J. chem. Phys., Vol. 32, No. 4, 1093-6 (April, 1960).

The frequency distribution spectrum of the normal modes of vibration for a noncentral force model of indium is approximated by a root-sampling technique. Interactions between an atom and its first and second-nearest neighbours are considered, the interatomic force constants being evaluated from the room-temperature elastic constants of indium. The calculated specific heat of indium from 4° to 80°K is in fairly good agreement with experiment.

539.2 : 539.3

6018 SPECIFIC HEAT AND ELASTIC CONSTANTS OF CALCIUM FLUORIDE AT LOW TEMPERATURES.
D.R.Huffman and M.H.Norwood.
Phys. Rev., Vol. 117, No. 3, 709-11 (Feb. 1, 1960).

Measurements of specific heat from 3.5°K and of elastic constants from 4° to 300°K were made on single crystals of calcium fluoride. The Debye theta at 0°K, θ_0, as calculated from the specific heat data, is 508 ± 5°K. Values of the elastic constants at 4.2°K are $c_{11} = 17.4$, $c_{12} = 5.6$, and $c_{44} = 3.593$ in units of 10^{11} dynes/cm^2. θ_0 calculated from elastic constants is 513.6 ± 2.5°K. The two θ_0's are now in good agreement and are significantly greater than the value calculated from previous specific heat work.

539.2

6019 DEVIATIONS FROM MATTHIESSEN'S RULE AND LATTICE THERMAL CONDUCTIVITY OF ALLOYS.
P.G.Klemens.
Austral. J. Phys., Vol. 12, No. 2, 199-202 (June, 1959).

Points out that the difference between the electronic thermal resistivity of an alloy and that of its principal pure metal constituent can be estimated, by means of the Wiedemann-Franz law, from the corresponding difference in the electrical resistivities. Hence the separation of the lattice and electronic components of the thermal conductivity can be made with greater confidence. L.Pincherle

539.2

6020 THE THEORY OF THE THERMAL CONDUCTIVITY OF DIELECTRICS. V.L.Gurevich.
Fiz. tverdogo Tela, Vol. 1, No. 9, 1474-6 (Sept., 1959). In Russian.

Usually the study of the effect of optical vibrations on thermal conductivity yields nothing of interest. In this theoretical paper, the case where the unit crystal contains two atoms of markedly differing mass is considered and the results of 2, 3 and 4 phonon collisions are discussed. It is shown that in the possible case where the thermal conductivity of longitudinal optical phonons plays a predominating role, at high temperatures the thermal conductivity is proportional to $T^{-\frac{1}{2}}$ and not to T^{-1} or $T^{-5/4}$. At temperatures below that for excitation of phonons the growth is exponential.

C.R.S.Manders

539.2

6021 THERMAL CONDUCTIVITY OF SOME DILUTE SILVER ALLOYS AT LOW TEMPERATURES AND IN MAGNETIC FIELDS. M.S.R.Chari and J.de Nobel.
Physica, Vol. 25, No. 1, 60-72 (Jan., 1959).

Results of investigations on thermal conductivity of dilute Ag–Mn alloys and of dilute Ag–In alloy are given. It is anomalous that a magnetic field causes an increase in the conductivity of alloys containing manganese at liquid helium temperature amounting even to 20% in fields of 25 kOe for the alloy with 0.14 at.% Mn.

539.2

6022 THERMAL CONDUCTIVITY OF SOME STEELS AT LOW TEMPERATURES. M.S.R.Chari and J.de Nobel.
Physica, Vol. 25, No. 1, 73-83 (Jan., 1959).

The measurements made in the Kamerlingh Onnes Laboratory on the thermal conductivity of steels at low temperatures were extended to liquid helium temperatures and the technique improved. Five specimens of different composition and heat treatment have been investigated. The lattice conductivity is approximately proportional to $T^{1.5}$. With increasing "nickel content" from 2% to 27% (Ni + Cr) it decreases by about 60, 58 and 37% at the temperatures 70, 20 and 4°K respectively. The electronic thermal conductivity decreases by about 80% for the temperatures mentioned.

539.2

6023 THERMAL CONDUCTIVITY OF SOME NON-SUPERCONDUCTING ALLOYS AT LOW TEMPERATURES.
M.S.R.Chari and J.de Nobel.
Physica, Vol. 25, No. 1, 84-96 (Jan., 1959).

The results of investigations on the thermal conductivity of dilute alloys of manganese and of indium in silver (also in strong magnetic fields up to 25 kOe), and of some steels at low temperatures are compared with theoretical predictions. In this way, values for several coefficients in the terms representing different scattering processes are obtained.

539.2 : 536.21

6024 LATTICE THERMAL CONDUCTIVITY IN COPPER ALLOYS. T.Olsen.
J. Phys. Chem. Solids, Vol. 12, No. 2, 167-74 (Jan., 1960).

The thermal conductivity has been measured of a series of copper–zinc alloys in the range 4.2–1.1° K, and the lattice part of the conductivity was determined. The value obtained for K_{ge} is $1.1 \times 10^{-4}\ T^3\ W\ cm^{-1}\ deg^{-1}$, which is compared with the lattice thermal conductivity that can be deduced from ultrasonic measurements in pure copper Fom this it is estimated that the shear thermal modes carry about 25 times as much heat as the longitudinal one. As expected theoretically, the shear wave interaction with electrons is found to be much smaller for thermal phonons than with ultrasonic waves The residual electrical resistance was also measured in the same copper-zinc alloys

539.2 : 536.21 : 537.3

6025 THE LATTICE THERMAL CONDUCTIVITY OF SOME GOLD ALLOYS.
J.A.Birch, W.R.G.Kemp, P.G.Klemens and R.J.Tainsh.
Austral. J. Phys., Vol. 12, No. 4, 455-65 (Dec., 1959).

The electrical and thermal conductivities of the following gold alloys have been measured from 2° to 90°K: Au–0.7% Pt, Au–1.6% Pt, Au–1.8% Pt, Au–0.65% Cr, and Au–6.2% Cr. Their lattice thermal conductivities have been deduced and the effects of annealing studied. It is found that in well-annealed dilute alloys, the lattice conductivity at liquid helium temperatures approaches a value consistent with theoretical predictions. It appears that increasing solute content causes an increasing dislocation density, which cannot be reduced substantially by annealing. This effect is more pronounced in the case of the chromium alloys. The lattice thermal conductivities at liquid oxygen temperatures compared with theory reveal numerical discrepancies, similar to those found in copper alloys.

539.2 : 536.41

6026 THERMAL EXPANSION OF CAESIUM IODIDE BY X-RAY DIFFRACTION AND THE GRÜNEISEN'S PARAMETERS. P.D.Pathak and N.V.Pandya.
Curr. Sci., Vol. 29, No. 1, 14-16 (Jan., 1960).

Values of the cell constant a_t in angströms at approximately 50 deg C intervals between 30 and 603°C were measured. The relation between a_t and the temperature t °C is

$$a_t = 4.5575 + 2.142 \times 10^{-4} t + 7.954 \times 10^{-8} t^2,$$

and a graph of the linear expansion coefficient $\alpha = (1/a_t)\,(da_t/dt)$ against t is given. At 25°C, $\alpha = 47.8 \times 10^{-6}\ deg^{-1}C$. Calculated values for Q/2R and p in Grüneisen's relation

$$3(a_t - a_0)/a_0 = (E/Q)\,(1 - pE/Q)$$

are 24.34×10^3 and 6.8 respectively. S.Weintroub

539.2

6027 THE APPLICATION OF THE TIGHT BINDING METHOD TO THE INVESTIGATION OF ENERGY BANDS IN HEXAGONAL CLOSE-PACKED STRUCTURE. I. M.Miąsek.
Acta phys. Polon., Vol. 16, No. 5, 343-68 (1957).

Tables for the reduction of the matrix components of energy in the tight binding method are presented.

539.2

6028 THE APPLICATION OF THE TIGHT BINDING METHOD TO THE INVESTIGATION OF ENERGY BANDS IN HEXAGONAL CLOSE-PACKED STRUCTURE. II. M.Miąsek.
Acta phys. Polon., Vol. 16, No. 6, 447-69 (1957).

Gives the terms in the matrix components of energy which contain E-integrals for the neighbour atoms from the second to the fourth.

539.2

6029 THE APPLICATION OF THE TIGHT BINDING METHOD TO THE INVESTIGATION OF ENERGY BANDS IN HEXAGONAL CLOSE-PACKED STRUCTURE. III. M.Miąsek.
Acta phys. Polon., Vol. 17, No. 6, 371-87 (1958).

The matrix components of energy are calculated, taking into account the interactions of further neighbours of order 2, 3, 4 in the two-centre approximation.

539.2

6030 APPLICATION OF THE EQUIVALENT ORBITAL METHOD TO THE STUDY OF BAND STRUCTURE IN COMPOUNDS OF THE TYPE $A^{III}B^{V}$. A.I.Gubanov and A.A.Nran'yan.
Fiz. tverdogo Tela, Vol. 1, No. 7, 1044-52 (July, 1959). In Russian.

Discusses relative merits and relation between tight-binding and equivalent orbital methods. The latter is used to obtain analytical expressions for energy-wave vector relation for 4-valence bands and the 4-conduction bands. The coefficients in these expressions for specific materials will be given in subsequent papers. It is established that on passing from group IV elements to III–V compounds an additional zone separating the 3rd and 4th bands is created both inside the 4-valence bands and inside the 4-conduction bands.

R.Berman

539.2

6031 ENERGY LEVELS IN A DISTORTED COULOMB FIELD. Ya.B.Zel'dovich.
Fiz. tverdogo Tela, Vol. 1, No. 11, 1637-41 (Nov., 1959). In Russian.

It is shown that the energy levels in a Coulomb field are usually unaffected by a perturbation which is confined to a small region near the origin. A noticeable modification is only possible if the perturbing potential has a resonance for the scattering of particles with small energies. Without the use of perturbation theory it is shown that then the change in energy of the Coulomb levels is proportional to the density of particles given by the unperturbed solution at the origin. R.B.Stinchcombe

539.2

6032 ELECTRONIC ENERGY LEVELS AND CRYSTAL QUANTUM STATES OF Tm (IV).
J.B.Gruber and J.G.Conway.
J. chem. Phys., Vol. 32, No. 4, 1178-82 (April, 1960).

To date limited agreement has been obtained between theory and experiment for $4f \rightarrow 4f$ transitions for Tm (IV) ($4f^{12}$). It is clear from the considerations that have appeared so far in the literature that intermediate coupling is important in the case of Tm (IV). Solutions of the intermediate field equations yield $\zeta_{4f} = 2700\ cm^{-1}$, $F_2 = 450\ cm^{-1}$, and $\chi = (\zeta/F_2) = 3$. Experimental agreement to $\pm 200\ cm^{-1}$ was obtained.

539.2

6033 SIMPLIFIED CONFIGURATION COORDINATE MODEL FOR KCl:Tl. P.D.Johnson and F.E.Williams.
Phys. Rev., Vol. 117, No. 4, 964-9 (Feb. 15, 1960).

The configuration coordinate model for KCl:Tl has been modified recently (Abstr. 5912 of 1959) to include the effect of the crystalline field on spin-orbit interaction. The spectral data on KCl:Tl and related phosphors have now been re-examined and a simplified configuration coordinate model is proposed which also includes this effect. In the simplified model the two excited states are approximately parallel, the upper state being predominately singlet; the lower, triplet. In contrast to the earlier model, the pure $^1P^o$ and $^3P^o$ spin states do not cross, and thus spin-dependent crystalline interactions which vary rapidly with configuration coordinate are avoided. The effects of crystalline interactions on the energy separation of the spin states and on the spin-orbit coupling constants are estimated theoretically. In the quantitative application of the one dimensional model to absorption and emission spectra neglecting configuration interaction with other crystal states, spin-orbit coupling constants which are smaller than the free ion values are used. The application of the model to other alkali halide phosphors and the origin of spectra not readily explained with the simplified model are discussed.

539.2

6034 ON THE THEORY OF COLLECTIVE EXCITATIONS OF THE ELECTRON SYSTEM IN A SOLID.
G.I.Guseva and G.G.Taluts.
Fiz. Metallov i Metallovedenie, Vol. 7, No. 5, 658-65 (1959). In Russian.

The spectrum of collective excitations of the electron system of a solid is investigated by the method of collective coordinates and impulses. The spectrum has two branches, one corresponding to plasma vibrations the other to excitons. 11 references.
A.F.Brown

539.2

6035 ELASTIC SCATTERING OF A MOTT EXCITON ON A Na^+ ION IN THE BORN APPROXIMATION.
Z.S.Kachlishvili.
Fiz. tverdogo Tela, Vol. 1, No. 11, 1747-9 (Nov., 1959). In Russian.

The differential scattering cross-section is evaluated and approximations are given for small and large angles. The total cross-section is found to be $\sim 10^{-11}$ cm^2. The mean free path is compared with that for phonon scattering and, for an ion density of 10^{18} cm^{-3}, ion scattering is found to be dominant at low temperatures and equal to phonon scattering at 13°K. D.J.Huntley

539.2

6036 THE STRUCTURE OF EXCITON BANDS IN ALKALI HALIDES. F.Fischer and R.Hilsch.
Nachr. Akad. Wiss. Göttingen, math.-phys., Kl. IIa, 1959, No. 6, 241-53. In German.

The exciton absorption spectra of alkali iodides, CsBr and RbCl were measured on 300 A thick evaporated layers down to a wavelength of 159 mμ. Comparison of the spectra obtained at 14°K and at various higher temperatures with the vapour spectra, enabled atomic terms to be related to those of the crystal. Measurements on thicker layers showed that the second excitation band for excitons coincides with a step in the alkali iodide spectrum. The edge of the absorption continuum and the binding energy of the excitons in the ground state are calculated. The exciton effective mass for the various alkali iodides and chlorides is between 0.2 and 0.5 m_e.
J.Franks

539.2

6037 MILLIMETER CYCLOTRON RESONANCE IN SILICON. C.J.Rauch, J.J.Stickler, H.J.Zeiger and G.S.Heller.
Phys. Rev. Letters, Vol. 4, No. 2, 64-6 (Jan. 15, 1960).

Measurements were made at 136 kMc/s between 1.2° and 50°K. The effective electron masses in different crystal directions are derived. K.W.Plessner

Defect Properties

539.2

6038 CONTRIBUTIONS FROM THERMAL LATTICE DEFECTS TO THE ENERGY CONTENT OF Au, Ag, Cu AND Al.
G.Borelius.
Ark. Fys., Vol. 15, Paper 5, 65-80 (1959).

The energy due to thermal lattice defects is determined assuming that the vibrational energy approaches 3 RT with increasing temperature. The vibrational zero-point energy and the energy due to thermal lattice defects are obtained; part of the lattice defect energy is due to vacancies which become important near the melting point, the major part of the energy is due to defects of an unidentified structure. J.Franks

539.2

6039 ON THE PROBLEM OF LARGE ANGLE GRAIN BOUNDARIES. E.F.Holländer.
Czech. J. Phys., Vol. 9, No. 6, 754-5 (1959).

A model of n simple parallel dislocation boundaries is used to obtain an expression for the energy of a large-angle grain boundary. Read and Shockley's expression is also extended by assuming that the radius around a dislocation within which Hooke's law fails depends on the angle of misfit of the boundary. J.E.Caffyn

539.2

6040 THE STRUCTURE AND ENERGY OF GRAIN BOUNDARIES IN METALS. K.A.Osipov.
Dokl. Akad. Nauk SSSR, Vol. 128, No. 2, 284-7 (1959). In Russian.

The author shows that for cubic lattices the energy of large angle grain boundaries is close to the activation energy q for the formation of regions of "local melting". Values of the maximum energy of a grain boundary are compared with values of q for a series of metals and good agreement is found, except for the case of aluminium. It is further suggested that the activation energy for several processes which occur at grain boundaries may be provided by the presence of the boundary, and hence that no thermal activation is needed. M.G.Priestley

539.2

6041 GRAIN GROWTH AND CREEP IN METALS. K.A.Osipov.
Dokl. Akad. Nauk SSSR, Vol. 128, No. 3, 529-31 (Sept. 21, 1959). In Russian.

The author discusses the activation energies for various processes in metals and suggests that in both grain growth and creep the activated state is one of maximum disorder in the crystal lattice, i.e. a state of "local melting". M.G.Priestley

539.2

6042 MOBILITY OF EDGE DISLOCATIONS IN SILICON-IRON CRYSTALS. D.F.Stein and J.R.Low,Jr.
J. appl. Phys., Vol. 31, No. 2, 362-9 (Feb., 1960).

A method was developed whereby the velocity of motion of fresh dislocations introduced into a crystal by scratching the surface may be measured as a function of stress. The velocities of unpinned edge dislocation in 3¼% silicon–iron was measured as a function of stress over a range of five orders of magnitude in velocity from 10^{-7} to 10^{-2} cm/sec. The velocity was found to be very sensitive to the applied stress in this velocity range. Measurements of velocity as a function of stress was made for four temperatures in the range 78° to 373°K. It was found that over this range of temperature the yield stress changes with temperature in the same way as the stress to produce a constant velocity of dislocation motion. From the result it is concluded that the rise in yield stress at low temperatures exhibited by this solicon iron is due primarily to an increase in the lattice resistance to dislocation motion and not to an increase in the Cottrell locking force. Preliminary experiments on pinned dislocations suggest that there may also be an effect of temperature on the strength of pinning by impurities which would be superimposed on the increase in lattice resistance with decreasing temperature.

539.2 : 534.23

6043 PHONON VISCOSITY AND ITS EFFECT ON ACOUSTIC WAVE ATTENUATION AND DISLOCATION MOTION.
W.P.Mason.
J. Acoust. Soc. Amer., Vol. 32, No. 4, 458-72 (April, 1960).

When dislocations move through a crystal, they are damped by some thermal mechanism. It is shown in this paper that good agreement with available measurements is obtained if the dislocations are damped by phonon viscosity. Phonons are quantized sound waves, which carry the thermal energy in an insulator. The interchange of energy between the longitudinal branch and the two shear branches occurs through the nonlinear elastic constants of the solid and requires a finite time τ. The effect of a shear wave, which is equivalent to a compression in one direction and an equal extension at right angles, is to raise the instantaneous temperatures for those phonons having components along the compressed direction and to

lower the temperature for those having components along the extended direction. The flow of heat between the hot and cold phonons produces a damping of the sound wave corresponding to a viscosity $\eta = E_0 K/C_v V^2$ as long as the time of application of the shear wave is long compared to τ. When the product $\omega\tau \gg 1$ this source of loss disappers. Phonon viscosity contributes directly to the acoustic attenuation and indirectly produces a damping for dislocation motion. By using thermal and sound velocity measurements to evaluate the viscosity, it is shown that available data on the attenuation of sound in metals and nonconducting crystals are in agreement with the calculated values of dislocation damping by phonon viscosity. A direct check for both edge and screw dislocations is obtained from recent work on the velocity of dislocations in lithium fluoride. The variation of internal friction in quartz as a function of temperature is in agreement with the temperature variation of phonon viscosity, but is not in agreement with calculations by Eshelby and Leibfried on dislocation damping by thermoelastic effects and by phonon scattering.

539.2

6044 DIMENSIONAL CHANGES IN CRYSTALS CAUSED BY DISLOCATIONS. R.A.Toupin and R.S.Rivlin.
J. math. Phys. (New York), Vol. 1, No. 1, 8-15 (Jan.-Feb., 1960).

According to the classical linear elasticity theory, if one or more dislocations are introduced into a body of elastic material the average value of each of the infinitesimal strain components is zero; in particular, the change in volume is zero. This result seems not to be in accord with experimental data on cold worked metals. In this paper, nonlinear elasticity theory is used to show how changes in the average dimensions of elastic bodies, either isotropic or anisotropic, due to the introduction of dislocations, can be calculated. In particular, an explicit relation is derived between the resultant change in volume, the stored energy, and the pressure derivatives of the elastic moduli.

539.2

6045 THRESHOLD ENERGY FOR LATTICE DISPLACEMENTS IN α-Al_2O_3. G.W.Arnold and W.D.Compton.
Phys. Rev. Letters, Vol. 4, No. 2, 66-8 (Jan. 15, 1960).

The authors have made observations of the 205 mμ absorption produced in 0.0635 cm thick samples of α-Al_2O_3 using fast electrons of various energies. From their results they estimate threshold energies assuming the absorption is produced by defects caused by lattice displacement. They conclude that the data do not allow an unequivocal attribution of the effects to either aluminium or oxygen displacements. Estimates are also given for the oscillator strength corresponding to the two possibilities considered. J.W.Leech

539.2

6046 A THEORY OF THE COALESCENCE OF EXCESS VACANCIES ON COOLING A SOLID. V.I.Vladimirov.
Fiz. tverdogo Tela, Vol. 2, No. 1, 157-67 (Jan., 1960). In Russian.

It is shown that under certain conditions the coalescence of vacancies on cooling a solid material can give macroscopic defects of dimensions $> 10^3$a, where a is the unit cell size. The dependence of the defect size on rate of cooling is calculated and the influence of the emergence of vacancies at the surface is estimated. A.L.Mackay

539.2

6047 HIGH-TEMPERATURE SELF-HEALING OF SURFACE DEFECTS IN CRYSTALLINE SOLIDS.
Ya.E.Geguzin and N.N.Ovcharenko.
Dokl. Akad. Nauk SSSR, Vol. 130, No. 3, 537-40 (Jan. 21, 1960). In Russian.

The processes of self-diffusion and re-condensation are considered as possible mechanisms for the self-healing of surface defects. Experiments between 600° and 950°C on the levelling of graduation lines ruled on oxygen-free polycrystalline copper enabled the value of the self-diffusion coefficient to be estimated. R.F.S.Hearmon

539.2

6048 IMPURITY CONCENTRATION PROFILES IN ICE BY AN ANTHRONE METHOD. M.Smith and E.R.Pounder.
Canad. J. Phys., Vol. 38, No. 3, 354-68 (March, 1960).

Solutions of sodium carboxymethyl cellulose (CMC), sodium chloride, ethylene glycol, and ethyl alcohol in water were prepared and frozen under controlled conditions. The ice in each case was divided into horizontal sections, melted, and the amount of each impurity measured. The organic liquid and salt concentrations were found from refractive index values using a dipping refractometer, and the CMC content, after treatment with an anthrone solution, was measured with a spectrophotometer. Developments in the anthrone method are described. Qualitative tests were also made by freezing solutions of soluble dyes. In the freezing of aqueous solutions of CMC and the dyes, rejection of the impurity is almost complete. When solutions of salt or alcohol or glycol in water, or of CMC and alcohol or glycol in water, are frozen a surface concentration peak and a second peak about 7 mm below the surface, corresponding to a previously observed discontinuity in the crystal structure of impure ice, are found. The ability of alcohol or glycol to carry CMC or a dye to places in the ice structure not available to them in the absence of the organic liquid is noted.

539.2

6049 COLOUR CENTRES IN PENTAHYDRATE CRYSTAL OF SODIUM THIOSULPHATE. K.D.Prasad.
Indian J. Phys., Vol. 32, No. 12, 566-72 (Dec., 1958).

Pentahydrate crystals of sodium thiosulphate develop a yellow coloration after a few hours of irradiation by X-rays. Spectrophotometric analysis revealed that the coloured crystal had an absorption at about 400mμ. Even when kept in darkness, the crystal lost its coloration at a rate depending on the temperature. At −5°C the colour persisted for about 15 days without any appreciable bleaching and at 19°C it persisted for 36 hours with a lot of bleaching. The induced coloration disappeared rapidly when the crystal was exposed to monochromatic radiation of a wavelength lying in the region of its absorption band. A new absorption band at about 1000 mμ developed after bleaching of the crystal in complete darkness, whereas two new absoprtion bands, one at 1000 mμ and the other at about 580 mμ, the F' band, appeared after bleaching the coloured crystal by light of a wavelength lying in its X-ray induced absorption band.

539.2

6050 EFFECTS OF PLASTIC DEFORMATION AT 300° K ON THE X-RAY PRODUCTION OF COLOR CENTRES IN KCl AT 5 AND 78°K. H.N.Hersh and J.J.Markham.
J. Phys. Chem. Solids, Vol. 12, No. 2, 207-8 (Jan., 1960).

Plastic deformation of KCl crystals at room temperature followed by irradiation with X-rays at low temperatures did not cause a similar increase in F-centres as occurs under irradiation at room temperature. At low temperatures additional electron centres and Cl_2^- were formed. J.Franks

539.2

6051 PARAMAGNETIC RESONANCE AND OPTICAL ABSORPTION OF A V CENTER.
W.Hayes and G.M.Nichols.
Phys. Rev., Vol. 117, No. 4, 993-8 (Feb. 15, 1960).

The paramagnetic resonance and optical absorption spectra of KCl and KBr crystals containing divalent calcium, strontium or barium ions were investigated. After X-irradiation at 195°K a resonance spectrum is observed with three distinguishable centres; the centres are similar and each has approximate axial symmetry about a different cube edge. The optical spectra show bands near 325 mμ in KCl and near 345 mμ in KBr which arise from the same centres. The centres are assigned to Cl_3^- and Br_3^- molecule ions and are closely related to the Cl_2^- and Br_2^- centres of Castner and Klinzig [J. Phys. Chem. Solids, Vol. 3, 178 (1957)].

539.2

6052 FORMATION OF F CENTERS AT LOW AND ROOM TEMPERATURES. H.Rabin and C.C.Klick.
Phys. Rev., Vol. 117, No. 4, 1005-10 (Feb. 15, 1960).

The X-ray production of F-centres at liquid helium temperature has been found to be primarily dependent on the type of alkali halide and not on the defect structure of the particular specimen, in contrast to observations at room temperature. This result indicates that the low-temperature production of F-centres is a bulk property of the alkali halide and occurs as a result of the creation of halide ion vacancies by the ejection of halide ions from their normal lattice sites. The formation of F- and H-centres in pairs at liquid helium temperature is in accord with this model and is supported by the fact that the energy required to produce an F-centre at liquid helium temperature in a variety of akali halides depends on the interstitial space available for accepting the halide atom. A comparison of the energy required of form F-centres under various conditions at low temperature and at room temperature gives additional evidence for a two-stage coloration process at room temperature.

539.2

6053 ELECTRONIC STRUCTURE OF THE "ANTIMORPH" OF THE F CENTRE. W.Känzig.
Phys. Rev. Letters, Vol. 4, No. 3, 117-18 (Feb. 1, 1960).

X-irradiated lithium fluoride shows a paramagnetic resonance spectrum which is attributed to a positive hole trapped at a Li^+ ion vacancy. However, the symmetry of the centre differs from that of an F-centre and is characteristic of a F_2^- molecular ion. The hole is localized on two fluorine ions which are non-equivalent for general orientations of the static magnetic field. The trapped holes are stable below 125°K. G.F.J.Garlick

539.2

6054 ELECTROLYTIC COLORATION OF POTASSIUM BROMIDE. W.Dunstan.
Proc. Phys. Soc., Vol. 73, Pt 6, 962-4 (June, 1959).

Describes experiments which reveal occasional disagreement with the prediction of Mott and Gurney. A red colour is then obtained by electrolysis, which does not disappear on reversing the current or by heating. The coloration, which is near the V_1 band (4100 A) is accompanied by photoconductivity under illumination in the absorption band. It is thought that the effects are due to the presence of impurities. J.Thewlis

539.2

6055 MECHANISM OF DIFFUSION OF CHEMICAL COMPOUNDS IN CRYSTALS AND KINETICS OF REACTIVE DIFFUSION. B.Ya.Pines.
Fiz. tverdogo Tela, Vol. 1, No. 3, 482-8 (March, 1959). In Russian.

In crystals of chemical compounds and in fully ordered solid solutions the sites occupied by atoms of different types are not equivalent and they form individual sublattices. In such crystals equilibrium concentrations of vacancies are different in different sublattices; vacancies and atoms diffuse only in their own sublattices. Kinetics of reactive diffusion is also considered. A.Tybulewicz

539.2

6056 THE DIFFUSION OF CERTAIN IMPURITIES IN Bi_2Se_3 AND ZnSb. A.A.Kuliev.
Fiz. tverdogo Tela, Vol. 1, No. 8, 1176-8 (Aug., 1959). In Russian.

The diffusion coefficients of Fe and Cd were measured using radioactive tracers and found to be

Fe in Bi_2Se_3, $D = 1.25 \times 10^{-7} \exp(-10\,980/RT)$ cm²/sec,
Fe in ZnSb, $D = 2.23 \times 10^{-9} \exp(-6\,080/RT)$ cm²/sec,
Cd in Bi_2Se_3, $D = 1.39 \times 10^{-3} \exp(-21\,320/RT)$ cm²/sec,
Cd in ZnSb, $D = 2.80 \times 10^{-10} \exp(-3\,890/RT)$ cm²/sec.

D.J.Huntley

539.2

6057 ON THE INFLUENCE OF ADDED HALOGEN ON THE THERMAL CONDUCTIVITY AND DIFFUSION IN SELENIUM. M.I.Aliev and G.B.Abdullaev.
Fiz. tverdogo Tela, Vol. 1, No. 8, 1296-8 (Aug., 1959). In Russian.

Points out relations between thermal conductivity, activation energy for diffusion, melting temperature, interatomic distance etc. It is shown that the first two follow the same trend as a function of bromine concentration in selenium, with a minimum at about 0.1%. Subsequent rise is ascribed to recombination of bromine atoms into molecules, resulting in smaller phonon scattering cross-section and fewer centres of deformation. R.Berman

539.2

6058 DIFFUSION OF BORON INTO SILICON. A.D.Kurtz and R.Yee.
J. appl. Phys., Vol. 31, No. 2, 303-5 (Feb., 1960).

The diffusion of boron into silicon was investigated over a temperature range of 1050° to 1350°C using an open-tube vapour–solid diffusion technique at atmospheric pressure. A p–n junction method of measuring the diffused layer was used to determine the diffusion constant. Lower diffusivities and a somewhat lower activation energy (ΔH = 81 kcal) were obtained than those reported previously. The difference is attributed to variation of diffusivity with surface concentration and is discussed on the basis of field-aided diffusion theory.

539.2

6059 EFFECT OF OXIDE LAYERS ON THE DIFFUSION OF PHOSPHOROUS INTO SILICON.
R.B.Allen, H.Bernstein and A.D.Kurtz.
J. appl. Phys., Vol. 31, No. 2, 334-7 (Feb., 1960).

The diffusion of phosphorus from the vapour phase into single crystal silicon was studied. The experimental data are analysed in terms of a two-layer diffusion model, leading to the determination of a diffusion constant for phosphorus in the oxide. The resulting diffusion constant at 1150°C is found to be 2.1×10^{-15} cm/sec² with an activation energy of 1.4 eV.

539.2

6060 VOLUMES OF ACTIVATION. II. PRESSURE DEPENDENCE OF ACTIVATION PARAMETERS.
R.W.Keyes.
J. chem. Phys., Vol. 32, No. 4, 1066-7 (April, 1960).

The relation between activation volume and activation energy of diffusive processes which was previously proposed (Abstr. 9136 of 1958) is integrated to show how the activation free energy depends on the volume of the solid. The result is shown to be in agreement with the data of Nachtrieb et al. on the pressure dependence of the diffusion constant of sodium.

539.2 : 537.534

6061 DIFFUSION AND DESORPTION OF METAL IMPURITIES IN PLATINUM. R.C.Bradley.
Phys. Rev., Vol. 117, No. 5, 1204-7 (March 1, 1960).

Activation energies for the volume diffusion of certain impurities in polycrystalline platinum samples were obtained by studying the ions released from their surfaces at temperatures above 1000°C. For one Pt sample these energies were 4.7 ± 0.2 eV for the diffusion of Na, 4.4 ± 0.2 eV for K, and 3.7 ± 0.2 eV for Ca. For a second sample, however, all the energies were 10-15% higher. After periods of inert gas ion bombardment at room temperature, bursts of K^+ and Na^+ ions were released at temperatures of about 600°C and 700°C, respectively. Activation energies associated with this release were 1.9 ± 0.1 eV for K^+ and 2.6 ± 0.1 eV for Na^+. In this case there was close agreement between the two different samples.

539.2

6062 DETERMINATION OF THE EFFECTIVE CHARGE OF CALCIUM IONS IN NaCl–$CaCl_2$ MIXED CRYSTALS.
S.N.Banasevich, B.G.Lur'e and A.N.Murin.
Fiz. tverdogo Tela, Vol. 2, No. 1, 80-7 (Jan., 1960). In Russian.

The diffusion coefficient of radioactive Ca^{45} in NaCl crystals was measured as a function of temperature and electric field, using a counter technique. The results are compared with those of other workers for different ions, and are discussed theoretically in relation to the effective ionic charge. R.F.S.Hearmon

539.2

6063 INVESTIGATION OF THE DENSITY OF MIXED KCl–RbCl CRYSTALS AND DIFFUSION OF RUBIDIUM IONS IN THEM. L.L.Makarov, B.G.Lur'e and V.N.Malyshev.
Fiz. tverdogo Tela, Vol. 2, No. 1, 88-92 (Jan., 1960). In Russian.

The densities of mixed KCl–RbCl crystals were measured at 25°C, and the probable concentration of Schottky defects estimated. The calculated configurational entropy showed satisfactory agreement with experiment. The diffusion of Rb ions was investigated at 670°C using radioactive Rb^{86}, and the activation energy for the diffusion process estimated from the variation of diffusion coefficient with temperature. R.F.S.Hearmon

539.2

6064 FUNDAMENTALS OF THE PHYSICAL EFFECTS OF RADIATION ON SOLID BODIES. R.Sizmann.
Nukleonik, Vol. 1, No. 9, 357-68 (Dec., 1959). In German.

A summary of the effects of α, β and γ ray bombardment, together with bombardment by protons and neutrons, on solid bodies. The survey is based on published work. J.Thewlis

539.2

6065 DISLOCATION OF ATOMS IN A SOLID BY γ-RAYS. V.V.Galavanov.
Fiz. tverdogo Tela, Vol. 1, No. 3, 432-41 (March, 1959). In Russian.

Deals with mechanisms of formation of Frenkel' defects (interstitial atom–vacancy) in crystals subjected to bombardment with 1 MeV gamma-rays. The following defect-formation cross-sections were calculated: by elastic scattering of gamma-rays on nuclei (σ_{scatt}), by photoeffect ($\sigma_{p.e.}$), by elastic scattering of fast photoelectrons (σ_{phot}) and Compton electrons (σ_{Comp}) on nuclei. The values of σ_{phot} and σ_{Comp} were found for thick crystals ($l \gg R$, where l is the thickness of the crystals and R is the mean free path of electrons). Graphical integration was used to allow for the energy distribution of Compton electrons. For Germanium bombarded with

1.25 MeV gamma-rays these cross-sections were found to be: $\sigma_{scatt} \cong 2 \times 10^{-29}$ cm^2; $\sigma_{p.e.} \cong 10^{-27}$ cm^2; $\sigma_{phot} \cong 10^{-26}$ cm^2; $\sigma_{Comp} \cong 2 \times 10^{-25}$ cm^2. A.Tybulewicz

539.2

6066 THRESHOLD MEASUREMENTS AND THE PRODUCTION OF RADIATION DAMAGE IN THE NOBLE METALS.
J.W.Corbett and R.M.Walker.
Phys. Rev., Vol. 117, No. 4, 970-1 (Feb. 15, 1960).

The electrical resistivity changes induced by bombarding Cu, Ag, and Au at ~ 10° K with 1.5 MeV electrons were measured. It is inferred that the threshold energy T_d for radiation damage production in Cu, Ag, and Au is 22,30, and ≥ 40 eV, respectively. The fact that the T_d values are not the same for this homologous series of metals requires reconsideration of the comparison of deuteron radiation damage theory and experiment. This shows that even beyond the different T_d values, the damage process parameters in these materials are not identical.

539.2

6067 IONIC CONDUCTIVITY OF GAMMA IRRADIATED SODIUM CHLORIDE.
H.S.Ingham, Jr and R.Smoluchowski.
Phys. Rev., Vol. 117, No. 5, 1207-15 (March 1, 1960).

Single crystals of NaCl were subjected to about 5×10^5 roentgens of Co^{60} gamma irradiation at 5° C, and then rapidly heated and maintained at a fixed temperature in the range 65° to 135° C. The d.c. ionic conductivity at this temperature was measured by means of a vibrating reed electrometer as a function of time. It decreased in the temperature range 65° to 80° C during a period of several hours to a value that was less than the preirradiation conductivity by a factor which was typically about 30. The conductivity is presumed to be a direct measure of the number of positive ion vacancies. The data fit a rate equation describing the bimolecular process $A + B \rightarrow AB$, with an activation energy approximately equal to that of the mobility of the positive ion vacancies. This confirms the supposition that the change of conductivity reflects the clustering of the positive ion vacancies with other imperfections at a rate controlled by the diffusion of these vacancies. Above 100° C, many of the clusters appear to break up again with an accompanying increase of conductivity. The conducting vacancies appear to be localized in a rather small fraction of the total volume of the crystal.

ELECTRICAL PROPERTIES OF SOLIDS

(Superconductivity is included under Low-Temperature Physics)

539.2 : 537.3 : 537.7

6065 SENSITIVE METHOD FOR MEASUREMENT OF MAGNETO-RESISTANCE EFFECT WITH DIRECT CURRENTS AND WITH MICROWAVES. D.E.Clark and J.G.Assenheim.
Brit. J. Appl. Phys., Vol. 11, No. 1, 35-8 (Jan., 1960).

An experimental investigation is made of the magneto-resistance effect in bismuth at frequencies of 9.2×10^9, 1.5×10^9 and 1.1×10^9 c/s, in magnetic fields of intensities up to 6270 Oe. Some results were also obtained using direct current. The method developed for the measurements is one of high sensitivity. In general form the results are in agreement with the theoretical predictions of Donovan (Abstr. 6631 of 1954).

539.2 : 537.3 : 539.219

6069 THE INFLUENCE OF THE BREAKUP OF SUPER-SATURATED SOLID SOLUTIONS ON THE HALL EFFECT. A.V.Cheremushkina.
Fiz. Metallov i Metallovedenie, Vol. 6, No. 2, 268-71 (1958). In Russian.

The resistivity ρ and the ferromagnetic Hall constant R were measured for Fe-W alloys of 3.7 to 17.3 wt % W. Above the maximum solubility composition of 5.5% W the curves of ρ and R branch for quenched and annealed alloys. A relation $R = a\rho + b\rho^2$ is found to hold. The kinetic changes of ρ, R, the magnetic saturation and the coercivity during annealing at 660° C were examined.

D.J.Huntley

539.2 : 537.3

6070 NONLOCAL CURRENT–FIELD RELATIONSHIP IN METALS. J.L.Warren and R.A.Ferrell.
Phys. Rev., Vol. 117, No. 5, 1252-6 (March 1, 1960).

It is found that Chamber's formula (Abstr. 6515 of 1952) for the response of the conduction electrons of a metal to an internal transverse electric field must be supplemented by a diffusion current when it is used for longitudinal fields. A new derivation of Chamber's formula is given by means of the Boltzmann transport equation, and the additional diffusion term in the current is exhibited explicitly.

539.2 : 537.3

6071 CONDUCTION PROCESSES IN CONDENSED AROMATIC HYDROCARBONS. D.C.Northrop.
Proc. Phys. Soc., Vol. 74, Pt 6, 756-61 (Dec., 1959).

Conductivity has been measured as a function of temperature for evaporated hydrocarbon films and for hermetically sealed single-crystal specimens. A model is proposed which explains why the activation energy for conduction corresponds to a spectral region of low absorption. The model is consistent with the exciton theory of fluorescence and photoconductivity. The conduction levels are pictured as being localized in polarized regions of the lattice.

539.2 : 537.3

6072 A DIELECTRIC APPROACH TO IMPURITY CONDUCTION. D.G.H.Frood.
Proc. Phys. Soc., Vol. 75, Pt 2, 185-93 (Feb., 1960).

Impurity conduction is formulated on a dielectric basis. It is assumed here that the condition for the transition from insulator to metal is provided by the dielectric catastrophe which occurs through the polarizability of the neutral particle. On the basis of the Onsager formula, the contribution to the permittivity arising from the hydrogenic donor atoms is calculated assuming all catastrophic excited states merge with the continuum. The upper temperature limit of the phase transition from N discrete levels to N –1 discrete levels can then be estimated and in this way the donor activation energy is found to be a stepwise decreasing function of both temperature and donor concentration. The dielectric theory is next extended to include screening by the conduction electrons. With an appreciable number of carriers present the hydrogen model breaks down and there is no polar contribution to the dielectric constant. Furthermore, the donor activation energy decreases smoothly and more rapidly with increasing temperature and donor concentration than it would do had only the unscreened catastrophe been operative in producing the band model.

539.2 : 537.3

6073 ELECTRICAL CONDUCTIVITY OF DIELECTRICS IN STRONG SHOCK WAVES.
A.A.Brish, M.S.Tarasov, and V.A.Tsukerman.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 22-5 (Jan., 1960). In Russian.

The "electrocontact" method was used to measure the electrical conductivity of air, water and some solid dielectrics when acted upon by strong shock waves. The measured value of air conductivity in the shock-wave front was found to be 0.5 Ω^{-1} cm^{-1} and of water conductivity, 0.2 Ω^{-1} cm^{-1}. It is shown that at shock wave-front pressures close to 10^5 kg/cm^2 Perspex and paraffin wax conductivities rise to 100-200 Ω^{-1} cm^{-1} and approach that of metals.

539.2 : 537.3

6074 RELATION OF THE ELECTRICAL RESISTANCE TEMPERATURE DEPENDENCE AT LOW TEMPERATURES AND THE GALVANOMAGNETIC EFFECT IN STRONG AND MAGNETIC FIELDS. O.S.Galkina and L.A.Chernikova.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 3-6 (Jan., 1960). In Russian.

A study was made of the electrical resistance of nickel–copper alloys with 39.6, 44.55 and 49.6% of Cu in the 7-30° K temperature range. By applying the $T^{3/2}$ law to the temperature dependence of spontaneous magnetization I_s, the resistivity ρ can be related to ferromagnon concentration $n = 1 - I_s/I_0$ (I_0 is the intensity of magnetization for $T \rightarrow 0$) and the numerical value of the coefficient $(\rho - \rho_0)/n$ can be obtained (ρ_0—residual resistance). Comparison of this coefficient's value with $\Delta\rho/\Delta n$ ($\Delta\rho$ and Δn denote variations of ρ and n caused by changes of true magnetization in strong magnetic fields), demonstrates that these values are of the same order within the margin of measurement errors. This fact is regarded as an indirect confirmation of the assumption that resistance of ferromagnetic alloys at low temperatures is related to electron scattering on the irregularities of the lattice magnetic moments.

539.2 : 537.3 : 538.1

6075 TEMPERATURE DEPENDENCE OF THE HALL EFFECT IN PURE FERROMAGNETICS.
N.V.Volkenshtein and G.V.Fedorov.
Zh. eksper. teor. Fiz., Vo. 38, No. 1, 64-8 (Jan, 1960). In Russian.

Presents results of measurements of the Hall effect for 99.998% pure iron, nickel and cobalt from room temperature down to 4.2°K. it is shown that the existing theories are inadequate for satisfactory explanation of the experimental data.

539.2 : 537.3 : 538.1

6076 GALVANOMAGNETIC PROPERTIES OF METALS WITH OPEN FERMI SURFACES. II.

I.M.Litshits and V.G.Peschanskii.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 188-93 (Jan., 1960).
In Russian.

On the basis of an earlier theory of galvanomagnetic phenomena, detailed calculations were carried out for certain concrete types of Fermi surfaces, for example, the open surface constructed for copper by Pippard. It was found that the stereographic projection of resistances obtained for an open surface of this type is in good agreement with the experimental data for gold. The peculiarities of galvanomagnetic phenomena for a surface of the "corrugated plane" type were studied. A new type of angular singularity, connected with the sharp change in direction of the open trajectories on approaching the field direction perpendicular to the "corrugated plane" was investigated. Possibilities of a more complete reconstruction of the energy spectrum from galvanomagnetic properties of a metal are discussed.

539.2 : 537.3 : 535

ELECTRICAL CONDUCTION IN METALS AND THEIR OPTICAL CONSTANTS. See Abstr. 6165

539.2 : 537.3

6077 DETERMINATIONS OF MICROSCOPIC PARAMETERS OF ALUMINIUM FROM ITS OPTICAL CONSTANTS AND ELECTRICAL CONDUCTIVITY.

A.I.Golovashkin, G.P.Motulevitch and A.A.Shubin.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 51-5 (Jan., 1960). In Russian.

Measurements were made of the optical constants of aluminium in the 0.8-9 μ range at room and liquid-nitrogen temperatures. The d.c. conductivity and density of the same specimens were also measured. The data obtained were evaluated using the theory based on the quantum kinetic equation which takes into account electron–electron collisions. Concentration of conduction electrons, electron velocity on the Fermi surface and electron collision frequency were determined.

539.2 : 537.3 : 535

6078 THE ANOMALOUS SKIN-EFFECT AND THE OPTICAL CONSTANTS OF COPPER, SILVER, GOLD AND NICKEL IN THE INFRARED REGION.

I.N.Shklyarevskii and V.G.Padalka.
Optika i Spektrosk, Vol. 6, No. 6, 776-9 (June, 1959). In Russian.

Dingle's theory (1953) and the values of the optical constants of Cu, Ag, Au and Ni, determined earlier, were used to calculate the conduction electron densities, their relaxation times and other parameters. The calculations were made on the assumption that the electrical conductivity of thick metal films deposited in vacuo is equal to the conductivity of the bulk samples. A.Tybulewicz

539.2 : 537.3

6079 ELECTRICAL RESISTIVITY OF DYSPROSIUM SINGLE CRYSTALS.

P.M.Hall, S.Legvold and F.H.Speeding.
Phys. Rev., Vol. 117, No. 4, 971-3 (Feb. 15, 1960).

Resistivity measurements are reported on two single crystals of h.c.p. dysprosium metal in the temperature range 1.3° to 400°K. The two magnetic transitions at 90° and 175°K are very evident in the resistivity. Significant anisotropy is observed only above 175°K, which is the paramagnetic range; at 400°K, $\rho_\perp/\rho_\parallel = 1.5$. A prediction for the resistivity of polycrystalline dysprosium based on these measurements is seen to be in good agreement with the resistivity of a polycrystalline sample.

539.2 : 537.3

6080 ELECTRICAL RESISTIVITY OF EUROPIUM AND YTTERBIUM. M.A.Curry, S.Legvold and F.H.Spedding.
Phys. Rev., Vol. 117, No. 4, 953-4 (Feb. 15, 1960).

Electrical resistivity measurements from 1.3° to 300°K are reported. Europium exhibits a sharp peak in its resistivity at 90°K which must correspond to its magnetic ordering temperature. The shape of the peak indicates antiferromagnetic ordering below 90°K. Ytterbium has no sharp anomalies in its resistivity.

539.2 : 537.3 : 538.2

ELECTRICAL RESISTIVITY OF Au–Mn ALLOYS. TEMPERATURE DEPENDENCE. See Abstr. 4483

539.2 : 537.3 : 536.21

ELECTRICAL CONDUCTIVITY OF SOME GOLD ALLOYS. See Abstr. 6025

539.2 : 537.3

6081 HALL EFFECT AND CONDUCTIVITY OF IRON-NICKEL ALLOYS. W.Jellinghaus and M.P.de Andrés.
Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 3-4, 187-99 (1960).
In German.

Describes a number of experiments on Fe–Ni alloys of a wide range of composition carried out at 20°C. Resistivity values and various modes of the Hall effect were investigated and related to phase changes in the alloys. C.A.Hogarth

539.2 : 537.3

6082 ANISOTROPY OF ORDINARY HALL EFFECT IN SILICON IRON. E.Tatsumoto and T.Okamoto.
J. Phys. Soc. Japan, Vol. 14, No. 2, 226-7 (Feb., 1959).

Single crystal strips of 1.23% silicon iron were examined in fields up to 35 000 Oe and the extraordinary and ordinary Hall effects were observed at room temperature. The effects of tension in different crystal directions is much more marked for the ordinary Hall effect than for the more readily observed extraordinary effect. C.A.Hogarth

539.2 : 537.3

6083 THE ELECTRICAL RESISTANCE OF DILUTE MAGNESIUM AND ALUMINUM ALLOYS AT LOW TEMPERATURES. F.T.Hedgcock, W.B.Muir and E.Wallingford.
Canad. J. Phys., Vol. 38, No. 3, 376-84 (March, 1960).

Experimental data on the influence of type and concentration of impurity on the low-temperature resistance of the metals, magnesium and aluminium, is presented. In particular, comparison is made of the electrical behaviour of alloys formed using transition element impurities in the divalent metal magnesium, and in the trivalent metal aluminium with the behaviour of similar impurities in some of the noble metals.

539.2 : 537.3

6084 ELECTRICAL PROPERTIES OF DILUTE ALLOYS OF ZINC WITH MANGANESE AT LOW TEMPERATURES.

Y.Muto, Y.Tawara, Y.Shibuya and T.Fukuroi.
J. Phys. Soc. Japan, Vol. 14, No. 3, 380-1 (March, 1959).

The variation of electrical resistance with temperature and with magnetic field has been studied for alloys of 0.099 and 0.43 atomic % Mn in 99.96% pure Zn in the liquid hydrogen and liquid helium temperature ranges. For the more dilute alloy, a resistance minimum appears at about 14°K; also at hydrogen temperatures the resistance increases with magnetic field and at helium temperatures decreases. The other alloy shows similar properties. The behaviour is considered similar to that of Cu–Mn alloys and is presumed to be related to the magnetic properties of Mn ions. L.Mackinnon

539.2 : 537.3

6085 PRESSURE DEPENDENCE OF THE RESISTIVITY OF ZINC OXIDE.

A.R.Hutson, W.Paul, W.Howard and R.B.Zetterstrom.
Z. Phys., Vol. 156, No. 2, 151-4 (1960).

The change of resistivity of n-type ZnO with hydrostatic pressure has been found to be 2.2×10^{-6} per kg cm^{-2} and is nearly linear for pressures up to 28 000 kg/cm^2. This result can be shown to be incompatible with a simple model of electron mobility which assumes that the scattering due to acoustic modes arises from a deformation potential associated with lattice dilatation.

Semiconductors

539.2 : 537.311

6086 SPACE CHARGE OSCILLATIONS IN SEMICONDUCTORS AT HIGHER FIELD INTENSITIES.

K.W.Böer and R.Rompe.
Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 3-4, 200-2 (1960).
In German.

Presents a preliminary report on space-time oscillations of space charge in the interior of CdS single crystals that may be

observed directly by electro-optical methods. Attention is drawn to the similarity of these oscillations in solids to those occuring in low pressure gas discharges. G.C.Williams

539.2 : 537.311

6087 ON THE DISTRIBUTION OF CARRIERS IN A [SEMI-INFINITE] SEMICONDUCTOR. Z.Bodó.
Acta phys. Hungar., Vol. 11, No. 1, 1-33 (1960).

The distribution of carriers and change of potential are investigated for the case where minority carriers of arbitrary distribution are generated on the semiconductor's surface. The results are obtained for the case of not too strong generation in the form of exact integrals. As a special case, the light-spot diameter dependence of the photovoltage for generation by a circular light-spot is calculated. It is possible to determine the inner recombination and the surface recombination velocity, using experimental data.

539.2 : 537.311

6088 SCATTERING OF CURRENT CARRIERS ON IMPURITY CENTRES. Yu.V.Gulyaev.
Fiz. tverdogo Tela, Vol. 1, No. 3, 422-31 (March,1959). In Russian.

Deals with carrier scattering on ionized impurity atoms in semiconductors at low temperatures. A screened Coulomb potential $V(r) = (Ze^2/r)\exp(-r/a)$ was used as the scattering potential; "a" is the screening radius. A variational method was used to find effective scattering cross-sections. Expressions were obtained for the relaxation time and mobility of carriers in the two cases of attractive and repulsive potentials. In the latter case it was found (in qualitative agreement with Sclar (Abstr. 3257 of 1957), that Ramsauer–Townsend effects and resonance scattering may occur in semiconductors. These effects should occur at low temperatures in strongly compensated samples at high injection levels. The mobility formulae are shown to be applicable also in the case of scattering on neutral impurities (a suitable value of "a" has to be used). A.Tybulewicz

539.2 : 537.311

6089 A STUDY OF CARRIER SCATTERING MECHANISMS IN SEVERAL SEMIMETALS. M.N.Vinogradova, O.A.Golikova, B.A.Efimova, V.A.Kutasov, T.S.Stavitskaya, L.S.Stil'bans and L.M.Sysoeva.
Fiz. tverdogo Tela, Vol. 1, No. 9, 1333-44 (Sept., 1959). In Russian.

The authors give a large number of experimental results of measurements of mobility and thermoelectric power as functions of the carrier concentration and temperature for both n-type and compensated specimens of PbTe, Bi_2S_3, Bi_2Te_3, and Bi_2Se_3. The results are compared with the theoretical predictions for phonon and impurity scattering. The impurity ion scattering cross-section was also measured as a function of temperature, energy and carrier concentration. M.G.Priestley

539.2 : 537.311

6090 THE ENTRAINMENT OF IONS BY ELECTRONS IN SEMICONDUCTORS. V.B.Fiks.
Fiz. tverdogo Tela, Vol. 1, No. 8, 1321-3 (Aug., 1959). In Russian.

Collisions with electrons moving under the influence of the applied field will modify the mobility of impurity ions. This effect could be used to study the scattering cross-section of electrons by ions of established varieties. It is shown that the mobility of positive ions can change sign for a sufficiently high concentration of electrons. Such an inversion should occur at temperatures ~1000°K in germanium and ~1600°K in silicon. R.B.Stinchcombe

539.2 : 537.311

6091 A POSSIBLE METHOD FOR THE DETERMINATION OF THE RATIO OF CAPTURE CROSS-SECTIONS AT RECOMBINATION CENTRES IN SEMICONDUCTORS. S.G.Kalashnikov and K.Konstantinescu.
Fiz. tverdogo Tela, Vol. 1, No. 11, 1763-6 (Nov., 1959). In Russian.

A new method is described which avoids the normally difficult measurement of lifetime. K.N.R.Taylor

539.2 : 537.311

6092 INTER-ELECTRON COLLISIONS AND THE "TEMPERATURE" OF HOT ELECTRONS. S.H.Koenig.
Proc. Phys. Soc., Vol. 73, Pt 6, 959-62 (June, 1959).

Reports measurements on n-type Ge of the field dependence of the angle between the current and electric field for large fields. In particular it is shown that anisotropy occurs in a crystal at a lattice temperature of 77°K with a free carrier concentration of 6.5×10^{15} cm^{-3}. This implies that the mean energies of the carriers in different valleys of the conduction band are not the same despite inter-electron collisions and invalidates Paige's interpretation of his experiments to measure the electron temperature using the piezoresistance effect (Abstr. 5705 of 1959). D.M.Edwards

539.2 : 537.311 : 538.2

MAGNETISM OF INTERACTING DONORS IN SEMICONDUCTORS.
See Abstr. 6215

539.2 : 537.311

6093 A COMMENT ON "CYCLOTRON RESONANCE IN SEMICONDUCTORS WITH COMPLEX EQUIPOTENTIAL SURFACES". Yu.A.Firsov.
Fiz. tverdovo Tela, Vol. 1, No. 3, 528 (March, 1959). In Russian.
See Abstr. 537 (1960).

539.2 : 537.311

6094 THE NATURE OF RELAXATION PROCESSES IN THE FIELD EFFECT. V.I.Lyashenko and N.S.Chernaya.
Fiz. tverdovo Tela, Vol. 1, No. 7, 1005-14 (July, 1959). In Russian.

Long-time relaxation processes in a transverse field were studied in 12-17 ohm cm n- and p-type Ge. The effect was examined at various fields and under various atmospheres of air, O_2, N_2, CO, and vacuum. It was found that external ionization of a surrounding air atmosphere increased the relaxation rate considerably. The integrated ion current between the condenser plates was found to be equal to the charge accumulated on the surface of the specimen. The results are explained by the mechanism of formation of ions in the medium surrounding the specimen due to electron emission from the surface of the semiconductor and the metallic electrode, and the subsequent gradual screening of the specimen from the field. D.J.Huntley

539.2 : 537.311

6095 ON THE THEORY OF IMPURITY BANDS. V.L.Bonch-Bruevich.
Fiz. tverdogo Tela, Vol. 1, No. 8, 1213-20 (Aug., 1959). In Russian.

The usual calculations lead to an exponential falling off in the impurity band width with increasing impurity interatomic distance, becoming vanishingly small for concentrations, N, of $10^{14} - 10^{15}$ cm^{-3}. This is not in agreement with the low-temperature conductivity. Neglecting overlap of the wave-functions of the discrete spectrum, it is shown that taking account of the continuous spectrum (virtual transitions to the conduction band of the semiconductor) leads to an impurity band width $\Delta W \sim N^{5/3}$. For germanium for $N \cong 2 \times 10^{14}$ cm^{-3}, $\Delta W > \sim 6 \times 10^{-5}$ eV. This has consequences for properties other than the kinetic coefficients, e.g. the recombination of current carriers. R.Berman

539.2 : 537.311

6096 ELECTROKINETIC EFFECTS IN LIQUID SEMICONDUCTORS. V.B.Fiks and G.E.Pikus.
Fiz. tverdogo Tela, Vol. 2, No. 1, 65-6 (Jan., 1960). In Russian.

In a liquid semiconductor in a capillary, a layer near the walls may carry a space charge which gives rise to electrokinetic effects similar to those in electrolytes. A longitudinal electric field gives rise to mass flow and a pressure gradient gives rise to an electric current. The coupling constant for a pair of coupled irreversible processes is, in accordance with Onsager's symmetry relations, assumed to be of the order of 10^{-4} cm.sec^{-1}.V^{-1}. R.Eisenschitz

539.2 : 537.311 : 621.382

6097 THE PIEZORESISTIVE EFFECT AND ITS APPLICATIONS. L.E.Hollander, G.L.Vick and T.J.Diesel.
Rev. sci. Instrum., Vol. 31, No. 3, 323-7 (March, 1960).

Piezoresistivity, the change in resistivity with applied stress, offers a tool for analysing the conduction mechanism in semiconductors and also offers potential transducer applications. A discussion of this effect in semiconductors and an analysis of the fourth-rank piezoresistive tensor for two crystal symmetries are presented. The magnitude of the effect in semiconductors is tabulated, including two materials, TiO_2 and PbTe, which the authors have determined to be of considerable interest. The design of devices based on piezoresistivity is discussed and illustrated by working models.

539.2 : 537.311

6098 NEGATIVE RESISTANCE IN SEMICONDUCTOR DEVICES. R.E.Burgess.
Canad. J. Phys., Vol. 38, No. 3, 369-75 (March, 1960).

Negative resistance can appear in the static and high-frequency

characteristics of devices in which the current is determined by both voltage and temperature. The properties of the a.c. impedance arising from the interaction of thermal and non-thermal effects are discussed and criteria for the appearance of negative resistance over certain ranges of frequency are derived. The application of this analysis to devices which do and which do not exhibit isothermal negative resistance is considered. A current–temperature relation depending on two activation energies is shown to provide a quantitative model for interpreting the observed turnover behaviour of germanium diodes.

539.2 : 537.311 : 621.382.2

6099 P–N JUNCTIONS AT LOW TEMPERATURES. B.M.Vul.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 1, 61-3 (Nov. 1, 1959). In Russian.

The space-charge equations at a p–n junction are investigated, using a number of approximations, valid at low temperatures, for junctions at which the impurity concentrations change discontinuously between uniform values. The step in potential is found to be largely confined to the less heavily doped material, and is equal in magnitude to the gap-width expressed in electron-volts. The differential capacitance is constant, and equal to the value attained at temperatures high enough for complete ionization of the impurities. The calculations are supported by capacitance measurements (see following abstract). I.D.C.Gurney

539.2 : 537.311 : 621.382.2

6100 CAPACITANCE OF P–N JUNCTIONS AT LOW TEMPERATURES. B.M.Vul and E.I.Zavaritskaya.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 10-17 (Jan., 1960). In Russian.

Capacitance of p–n junctions in germanium and silicon was measured down to liquid-helium temperatures. At very low temperatures the junction capacitance could not be measured because of the small series capacitance of the base between the junction and the electrodes. The observed effects can be explained by means of a simple equivalent circuit. The screening effect of an inversion layer in the space-charge region and the contact potential are also discussed. A.Tybulewicz

539.2 : 537.311

6101 THE RECTIFYING EFFECT OF AN ELECTROLYTE–N-TYPE SEMICONDUCTOR CONTACT.

Yu.A.Vdovin, B.M.Grafov and Myamlin.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 4, 827-30 (Dec. 1, 1959). In Russian.

Presents a theoretical study of the boundary separating two phases, where the reaction is of the type

$$A^+ + e \rightleftharpoons A \text{ or } A^- \rightleftharpoons A + e.$$

The problem differs from that of (Abstr. 13312 of 1959) in that the holes are taken into account and it is assumed that the donor levels are fully ionized and the acceptor levels completely filled in the semiconductor. The system of differential equations describing the semiconductor is written together with the conditions at ∞, using the notation of [Dokl. Akad. Nauk SSSR, Vol. 126, No. 6, 1296 (July 21, 1959)]. The boundary conditions at the contact are taken from (Abstr. 13312 of 1959). It is shown that, if the contact layer is impoverished by electrons as well as holes in equilibrium, original rectification unconnected, with the p–n junction occurs. D.E.Brown

539.2 : 537.311

6102 INVESTIGATION OF THE P–N JUNCTION FOR HIGH CURRENT DENSITIES. Yu.K.Barsukov.

Fiz. tverdogo Tela, Vol. 1, No. 11, 1659-67 (Nov., 1959). In Russian.

The blocking process, the diffusion voltage and the conductance of the basal layer are studied as a function of forward current for p–n junctions in In–Ge, for current densities between 10 and 1000 amp/cm^2. The inertia of the junction decreases with increasing forward current, due to the slowing down of the growth of minority carrier concentration. This is determined by the magnitudes of the forward and reverse currents, and not just their ratio as for smaller currents (up to 10 amps/cm^2). There is qualitative agreement with an approximate calculation. R.Berman

539.2 : 537.311 : 621.382

6103 ION DRIFT IN AN N–P JUNCTION. E.M.Pell.

J. appl. Phys., Vol. 31, No. 2, 291-302 (Feb., 1960).

If a reverse bias is applied to an n–p junction at a sufficiently elevated temperature to give either the donor or the acceptor ions appreciable mobility, the ions will drift in the electric field of the junction to produce an intrinsic semiconductor region between the n and p regions. Such ion drift offers a simple and straightforward method for investigating diffusion constants, as well as chemical interactions within the host lattice which affect this diffusion. Preliminary results indicate its feasibility for measuring the diffusion constant of Li in Si to as low as 10^{-14} cm^2/sec and also for measuring the effect of Li–oxygen and Li-acceptor interactions in decreasing the diffusion rate. Intrinsic regions resulting from ion drift have been used to produce diodes with breakdown in excess of 4000 V from low resistivity silicon. In addition, they can be used to extend the frequency range of devices by virtue of the decrease in junction capacitance associated with such an incorporated intrinsic region. Ion drift has also been used for the fabrication of analogue transistors, an early unit having an input impedance of 6 megohms, a power gain of 17 dB and a voltage gain of 4.

539.2 : 537.311 : 621.382.2

6104 PRESSURE DEPENDENCE OF THE CURRENT–VOLTAGE CHARACTERISTICS OF ESAKI DIODES. S.L.Miller, M.I.Nathan and A.C.Smith.

Phys. Rev. Letters, Vol. 4, No. 2, 60-2 (Jan. 15, 1960).

The log of the peak current is found to fall nearly linearly with pressure. After determining the dependence of the energy gap on pressure over the same range (0-30 000 kg/cm^2), it is deduced that the results are consistent with existing theories of the tunnel diode. K.W.Plessner

539.2 : 537.311 : 541.13

CONTINUOUS DEIONIZED WATER WASHING SYSTEM FOR SEMICONDUCTOR DEVICES. See Abstr. 4724

539.2 : 537.311

6105 IMPROVEMENT OF SEMICONDUCTOR SURFACES BY LOW MELTING GLASSES, POSSIBLY FUNCTIONING AS ION GETTERS. S.S.Flaschen, A.D.Pearson and I.L.Kalnins.

J. appl. Phys., Vol. 31, No. 2, 431-2 (Feb., 1960).

Coating surfaces of p–n diffused junction silicon diodes with low melting point sulphide and iodide inorganic glasses has resulted in a decrease of reverse current by two orders of magnitude from $\sim 10^{-6}$ to $\sim 10^{-8}$ A and an improved stability of the reverse characteristic. Removal of contamination from the surface by chemical diffusion into the glass and/or neutralization of induced surface charges by ion getters are proposed to explain experimental results. G.C.Williams

539.2 : 537.311

6106 THE TEMPERATURE DEPENDENCE OF THE TRAPPING COEFFICIENT OF ELECTRONS AT NEUTRAL LEVELS OF COPPER IN GERMANIUM. S.G.Kalashnikov and A.I.Morozov.

Fiz. tverdogo Tela, Vol. 1, No. 8, 1294-8 (Aug., 1959). In Russian.

The lifetime of electrons in copper doped germanium has been examined using the methods of photoconductivity and the photomagnetoelectric effect. The investigations were carried out in the temperature range from 100° to 320° K for several copper concentrations. The value of the trapping coefficient at 300° K was found to be 2×10^{-10} cm^3 sec^{-1}, corresponding to a capture cross-section of 1.5×10^{-17} cm^2. K.N.R.Taylor

539.2 : 537.311

6107 A STUDY OF SILVER AND GOLD LOCAL LEVELS IN GERMANIUM. K.D.Glinchuk, E.G.Miselyuk and N.N.Fortunatova.

Fiz. tverdogo Tela, Vol. 1, No. 9, 1345-50 (Sept., 1959). In Russian.

The authors studied the influence of annealing at 400–600° C on silver and gold impurity levels in germanium. Both carrier lifetime and the temperature dependence of carrier concentration were measured. The silver levels were "deactivated" by the anneal. It is concluded that the silver acceptor levels are highly effective recombination centres as their removal increases the carrier lifetime. The same measurements were made on gold impurity levels and there annealing produced no change in either carrier concentration or carrier lifetime. The energies and the capture cross-sections of the recombination levels were estimated from the data obtained. M.G.Priestley

539.2 : 537.311

6108 THE ELECTRICAL CONDUCTIVITY OF GERMANIUM AT LOW TEMPERATURES. I.A.Kurova and S.G.Kalashnikov.

Fiz. tverdogo Tela, Vol. 1, No. 9, 1476-9 (Sept., 1959). In Russian.

Observations of resistivity, the Hall constant and magnetoresistance have been made for high resistance germanium. Evidence is given for impurity-band conduction and the carrier concentration is found. K.N.R.Taylor

539.2 : 537.311

6109 MONOENERGETIC NEUTRON IRRADIATION OF GERMANIUM. O.L.Curtis, Jr and J.W.Cleland.

J. appl. Phys., Vol. 31, No. 2, 423-7 (Feb., 1960).

A study was made on 14 MeV neutron-irradiated germanium, using lifetime, Hall, and resistivity measurements to determine the nature of the radiation-induced defects and to compare the damage with that produced by neutrons from a fission spectrum. The electron removal rate in high-resistivity, n-type material is ~ 8/cm^{-3} per incident neutron/cm^2, measured at 77°K. Lifetime measurements was made on n- and p-type material. On the basis of simple recombination theory, assuming no variation of capture probabilities with temperature, the results for n-type material indicate that a recombination level is located 0.32 eV above the valence band near the centre of the energy gap. Assuming an introduction rate of recombination centres equal to one-half the electron removal rate in n-type material, the following values of recombination capture cross-sections are obtained: $\sigma_n = 2.2 \times 10^{-17}$ cm^2; $\sigma_p = 6 \times 10^{-15}$ cm^2, the latter value being correct only within about a factor of two. The ratio of the cross-sections, σ_p/σ_n, which is independent of the method of determining the number of recombination centres, is ~ 300, indicating that the recombination centres are negatively charged. The lifetime measurements for p-type germanium are not so readily analysed. Possible explanations for observed behaviour are discussed.

539.2 : 537.311

6110 RECOMBINATION CENTRES PRODUCED IN Ge BY FAST NEUTRONS. N.van Dong and A.Barraud.

J. Electronics and Control, Vol. 7, No. 3, 275-88 (Sept., 1959). In French.

The minority carrier lifetime was measured by the photoconductive decay method on n- or p-type crystals and by means of the short-circuit current of an illuminated grown p–n junction. Changes in the reciprocal lifetime were found to be proportional to the neutron flux over about a decade range in the neighbourhood of 10^{12}–10^{13} cm^{-2}. The trap depth derived from the temperature-dependence is 0.23 eV above the valence band for the n-type material, but more than one trap depth seems necessary to account for the data obtained for the p-type material. The annealing behaviours of the n- and p-Ge were markedly different. F.F.Roberts

539.2 : 537.311

6111 THE ANISOTROPY OF THE CONDUCTIVITY OF HOT ELECTRONS AND THEIR TEMPERATURE IN GERMANIUM. E.G.S.Paige.

Proc. Phys. Soc., Vol. 75, Pt 2, 174-84 (Feb., 1960).

By making certain simplifying assumptions a method of analysing the anisotropy of the conductivity of electrons in germanium at high electric fields is presented. The method is applied to Koenig's data on a specimen having a free carrier concentration of 6.5×10^{14} cm^{-3}. The electron temperatures in each valley are obtained and the mobility and population of carriers within the valleys are calculated. These electron temperatures are compared with electron temperatures calculated from an energy balance equation applied to each valley as though it existed independently of the other valleys. The comparison shows that there is interaction between electrons in different valleys. Estimates are made of the rate of energy transfer between valleys.

539.2 : 537.311

6112 A POSSIBILITY OF DISCOVERING EXCITONS IN GERMANIUM AND SILICON.

B.Ya.Moizhes and Yu.I.Ravich.

Fiz. tverdogo Tela, Vol. 1, No. 8, 1243-5 (Aug., 1959). In Russian.

It is suggested that an exciton contribution to the photoconductivity may be observed at low temperatures of the order of 1.5°K. A calculation of the probability of exciton formation for a simple Mott model with an isotropic effective mass leads to an estimate of the exciton concentration in an irradiated crystal. This is of the order of 10^{13}/cm^3, which should be high enough for the effect to be studied experimentally. M.G.Priestley

539.2 : 537.311

6113 AN ENERGY BARRIER BETWEEN THE SLOW SURFACE STATES AND THE BULK OF GERMANIUM AND SILICON.

I.I.Abkevich.

Fiz. tverdogo Tela, Vol. 1, No. 11, 1676-8 (Nov., 1959). In Russian.

Monocrystal specimens of 1.5, 3, 10 ohm.cm n-type Ge and 1 ohm.cm p-type Si were subjected to short-wave illumination of up to 5 eV and the changes in contact potential were measured. A flux of light quanta needed to produce a change of contact potential of 0.008 V in 10 sec after illumination ceases was found to decrease rapidly with the energy of light quanta and the curves had a kink between 3.15 and 3.45 eV. It is proposed that this energy is that of a barrier between the slow surface states and the bulk. Employing the usual tunnel-transition probability formula for energies less than that of the barrier, the latter's width is deduced to be between 5.8 and 8 A, narrowing at the top; the same result is obtained for freshly prepared specimens and those exposed to air for a month. D.J.Huntley

539.2 : 537.311

6114 THE INFLUENCE OF THE STATE OF THE SURFACE ON THE BREAKDOWN VOLTAGE OF SILICON DIODES.

Zh.I.Alferov and É.V.Silina.

Fiz tverdogo Tela, Vol. 1, No. 12, 1878-9 (Dec., 1959). In Russian.

The diodes were made by alloying Al on to n-type silicon with a resistivity of about 100 Ω cm. The base connection was made with SnAs alloy. The junction area was 10^{-3} cm^2 to ensure large surface effects. The junctions were carefully etched, washed and dried. The reverse characteristic was observed by driving the diodes with square wave pulses of 200 μsec duration at a repetition rate of 10 c/s in order to avoid heating. The reverse characteristics, shown in a figure, consist of three groups of measurements made in air, in vacuum, and after warming in vacuum. From the breakdown voltage the charge concentration in the surface layer for these groups is estimated as (6, 4 and 2) × 10^{14} cm^{-3} respectively. W.Bardsley

539.2 : 537.311 : 541.13

6115 ELECTRODE PROCESSES IN THE SYSTEM SILICON MONOCRYSTAL/SODIUM HYDROXIDE SOLUTION.

M.Seipt.

Z. Naturforsch., Vol. 14a, No. 10, 926-8 (Oct., 1959). In German.

Current–voltage characteristics were determined for a number of n and p-type silicon specimens, both in the dark and under illumination, and with various NaOH concentrations. It is deduced that the solution influences the carrier concentration in the blocking layer within the silicon, possibly by the penetration of hydrogen atoms. In addition, the presence of surface levels in the forbidden energy band is surmized. K.W.Plessner

539.2 : 537.311 : 548.5

THE CONTROL OF RESISTIVITY IN PULLED SILICON CRYSTALS. See Abstr. 4594

539.2 : 537.311 : 548.5

AlSb SINGLE CRYSTALS. GROWTH AND SEMICONDUCTING PROPERTIES. See Abstr. 4598

539.2 : 537.311 : 538.1

6116 HALL COEFFICIENT AND MAGNETORESISTANCE IN SEMICONDUCTING DIAMOND.

R.T.Bate and R.K.Willardson.

Proc. Phys. Soc., Vol. 74, Pt 3, 363-7 (Sept., 1959).

The Hall coefficient and transverse magnetoresistance of two type II-b semiconducting diamonds (p-type) were measured as a function of magnetic field from 500 gauss to 20 000 gauss at fixed temperatures between 0°C and 100°C. These diamonds have $R\sigma$ values of about 1000 cm^{2}v^{-1}sec^{-1} at room temperature. The Hall coefficient increases monotonically with increasing field, the total variation being about 10%. This behaviour is similar to that which has been reported for p-type silicon at liquid-nitrogen temperature, and it suggests a warped valence band. The transverse magnetoresistance is proportional to H^2 at low fields, but deviates from this behaviour at fields above 4000 gauss. The magnetoresistance is larger than would be expected for a spherical band but can be explained if a warped valence band is assumed. A warped band is also suggested by the longitudinal magnetoresistance which is about one-third the transverse third.

539.2 : 537.311

6117 TEMPERATURE-RESISTANT BARRIER-FREE CONTACTS ON CdS SINGLE CRYSTALS.

K.W.Böer and K.Lubitz.

Z. Naturforsch., Vol. 15a, No. 1, 91-2 (Jan., 1960). In German.

Vacuum-evaporated aluminium on single crystals of CdS, which are heated at 200°C during the deposition, can withstand a temperature of 350°C for 15 minutes in vacuo without forming a barrier layer. G.C.Williams

539.2 : 537.311

6118 A STUDY OF THE FIELD EFFECT IN CdS SINGLE CRYSTALS. J.Auth, G.Krenzke and E.A.Niekisch.
Z phys. Chem. (Leipzig), Vol. 213, No. 1-2, 17-29 (1960). In German.

Highly insulating crystals, illuminated either in the fundamental absorption region or in its tail, were investigated. A field effect was not detected in every crystal, and the magnitude of the effect depended on the ambient atmosphere, which was controlled. A theoretical interpretation is admitted to be difficult, but an attempt is made to consider the possible number of surface states and the influence of the donor states within the crystal on the field effect. K.W.Plessner

539.2 : 537.311

6119 INVESTIGATION OF THE EFFECTIVE MASS OF CURRENT CARRIERS IN GaSb. Z.Kopeć.
Acta phys. Polon., Vol. 17, No. 4, 265-71 (1958).

The thermoelectric force, Hall effect, and electric conductivity for 3 samples of p-GaSb and 1 sample of n-GaSb were measured in the region 200°-400°K. The scattering of carriers on phonons and ions were taken into account in calculating the values of the effective mass, the latter proving to be a function of both the concentration and the temperature. Additional measurements of the thermoelectric force and heat conductivity for one sample of the p-type and one of the n-type were made at lower temperatures (down to liquid helium) and indicate that for large current carrier concentrations the values obtained for the effective mass at the higher temperatures are not affected by the phonon drag effect.

539.2 : 537.311

6120 OPTICAL ENERGY GAP VARIATION IN THE GaSb–InSb SYSTEM.
J.C.Woolley, J.A.Evans and C.M.Gillett.
Proc. Phys. Soc., Vol. 74, Pt 3, 244-8 (Sept., 1959).

The production of specimens of alloys in the GaSb–InSb system suitable for electrical and optical work is first discussed. X-ray data are given to show the variation in composition and the degree of homogeneity of specimen sections cut from long rod ingots produced by very slow directional freezing techniques. The results of measurements of infrared transmission on such specimens are presented together with a graph of the variation of wavelength for onset of transmission, interpreted as optical energy gap, as a function of composition. The form of this graph is briefly discussed.

539.2 : 537.311

6121 MAGNETORESISTANCE IN GALLIUM ARSENIDE.
R.K.Willardson and J.J.Duga.
Proc. Phys. Soc., Vol. 75, Pt 2, 280-90 (Feb., 1960).

The transverse magnetoresistance in n-type gallium arsenide has been studied as a function of impurity concentration and density of defects introduced by fast-neutron irradiation. The data are consistent with theoretical predictions based on mixed scattering and a spherical-energy-surface model. The change in the magnetoresistance with fast-neutron bombardment suggests the introduction of levels other than the deep-lying ones revealed by changes in the carrier concentration and that some of these levels may be multiply ionized.

539.2 : 537.311

6122 PREPARATION AND ELECTRICAL PROPERTIES OF ALLOYED P–N JUNCTIONS OF InSb.
C.A.Lee and G.Kaminsky.
J. appl. Phys., Vol. 30, No. 12, 2021-2 (Dec., 1959).

p–n junctions were prepared by alloying Cd on n-type InSb and by diffusing Zn into n-type InSb. The InSb had an excess donor density of 1.3×10^{15} cm^{-3} and a Hall mobility of 10^5 cm^2 volt^{-1}sec^{-1}. After etching with diluted CP-4 rectification was observed with these junction at liquid nitrogen temperatures, the reverse current being greater than the saturation current expected from the minority carrier density and the authors' estimate of lifetime. The capacitance is shown to be proportional to $V_B^{-\frac{1}{2}}$, where V_B is the barrier voltage. Surface leakage presents a problem, but these InSb diodes are considered suitable for use in variable capacitance parametric amplifiers. I.Cooke

539.2 : 537.311 : 538

6123 INDIUM ARSENIDE HALL-EFFECT PROBES FOR MEASURING THE MAGNETIC FIELD INTENSITY.
N.V.Zotova and D.N.Nasledov.
Fiz. tverdogo Tela, Vol. 1, No. 11, 1690-4 (Nov., 1959). In Russian.

The temperature dependence of the electrical conductivity and the Hall constant, and the effect of magnetic fields on the Hall constant and the Hall e.m.f. of InAs were determined. The Hall-effect probes were made from mono- and polycrystalline InAs specimens, and their characteristics were studied. It is claimed that the small size of these devices (8 × 4 × 0.2 mm), their simplicity and high accuracy make them eminently suitable for measuring magnetic field intensities in a wide range of applications. M.H.Sloboda

539.2 : 537.311

6124 THERMOMAGNETIC NERNST-ETTINGSHAUSEN EFFECTS IN INDIUM ARSENIDE.
O.V.Emel'yanenko, N.V.Zotova and D.N.Nasledov.
Fiz. tverdogo Tela, Vol. 1, No. 12, 1868-71 (Dec., 1959). In Russian.

Reports the results of measurements of the longitudinal and transverse Nernst-Ettingshausen Q-coefficients of four specimens of indium arsenide, n-InAs. Specimen 1 had the highest attainable purity and 2, 3 and 4 had increasing impurity content in that order. The corresponding concentrations of electrons range from 7×10^{16} cm^{-3} in 1, to 9×10^{18} cm^{-3} in 4, at room temperature. The variation with temperature of the Q-coefficients of the electrical conductivity σ, and of the Hall coefficient R, for the first specimen are shown graphically. The variation with temperature of the Q-coefficients for specimens 2,3 and 4 is shown. It is found that with increasing concentration of electrons, going from specimens 1 to 4, the absolute values of the Q-coefficients decrease. This is explained as a result of the increase in degeneracy of the electron gas, and a numerical table supports this view. In specimen 1, at low temperatures, impurity conduction predominates, changing to intrinsic conduction at about 350°K, whereas in the others impurity conduction predominates right up to 600°K. The greater the impurity, i.e., the more alloyed the specimen, the more the carriers of current are scattered among the thermal oscillations of the lattice. The reasons for these and other results are discussed qualitatively. See Abstr. 9625 of 1959. N.Davy

539.2 : 537.311

6125 THE INFLUENCE OF IMPURITY ON THE EFFECT OF A STRONG FIELD IN SELENIUM RECTIFIERS.
G.B.Abdullaev, M.G.Aliev and I.Kh.Geller.
Fiz. tverdogo Tela, Vol. 1, No. 11, 1670-5 (Nov., 1959). In Russian.

The increase of reverse current results from increased conductance of a p–n junction in strong fields, related to the increase in number and mobility of free carriers. The temperature coefficient of reverse resistance is measured as a function of voltage for various bromine concentrations. The temperature at which the coefficient changes sign depends on purity. Higher purity moves the inversion point to lower temperatures and higher voltages. R.Berman

539.2 : 537.311

6126 ELECTRONIC STRUCTURE OF SEMI-CONDUCTING SELENIUM AND TELLURIUM. R.Gáspár.
Acta phys. Hungar., Vol. 7, No. 3, 289-311 (1957).

By taking the lattice structure of the crystal and the electronic structure of the atoms into account, the energy band spectra of Se and Te are determined, a main characteristic of which is that the valence and conduction bands are composite. Both the valence and the conduction bands are superpositions of two bands. In one of the overlapping bands, the mobility of charge carriers is small, while in the other it is large. Some qualitative indication of the relative positions of the overlapping bands in given. Callen's electronic structure scheme is analysed in detail (Abstr. 6766 of 1954).

539.2 : 537.311 : 535.33

6127 THEORETICAL INTERPRETATION OF THE OPTICAL AND ELECTRICAL PROPERTIES OF TELLURIUM, SELENIUM AND THEIR ALLOYS. R.Gáspár.
Acta phys. Hungar., Vol. 7, No. 3, 313-24 (1957).

Based on the findings of the previous abstract, a theoretical interpretation is presented of the dependence of the infrared absorption spectrum of tellurium on the polarization of incident radiation, of the soft X-ray absorption spectrum of selenium and tellurium, of the anisotropy of electrical conductivity and of the anomalous variation of Hall coefficient of tellurium with temperature.

539.2 : 537.311

6128 ELECTRIC CONDUCTIVITY OF SOME OXIDES OF TITANIUM AND VANADIUM.

S.M.Ariya and N.I.Bogdanova.

Fiz. tverdogo Tela, Vol. 1, No. 7, 1022-6 (July, 1959). In Russian.

Conductance measurements carried out by the potentiometric probe method with cold-pressed tablets of Ti and V oxides, sintered at high temperatures (1250-1300° C for Ti and 1600° C for V) and in a high vacuum, showed that: (1) the conductance of the discrete intermediate compounds, in which V is present in the ter- and quadrivalent state, differs from that of the mixture of V_2O_3 and VO_2; and (2) in the region $TiO_{1.00}$–$TiO_{1.20}$, conductance is close to that of the mixture of $TiO_{1.00}$ with $TiO_{1.20}$; the dependence of conductance on composition in the region where TiO is homogeneous (and rich in O), i.e. $TiO_{1.00}$–$TiO_{1.25}$, is similar to that found in the region $VO_{1.50}$–$VO_{1.67}$ which corresponds to the heterogeneous region of the V–O system. F.Lachman

539.2 : 537.311

6129 IMPROVED SEMICONDUCTOR-TO-COPPER SOLDERED CONTACT. G.Reichenbaum.

Brit. J. appl. Phys., Vol. 10, No. 10, 469-70 (Oct., 1959).

The solder is allowed to spread into the semiconductor-base metal gap by capillary action from a small pellet in a groove on one side. Over 90% wetting is claimed in every device made in this way, thereby ensuring good transient overload characteristics. F.F.Roberts

Photoconductivity

539.2 : 537.312

6130 ANALYSIS OF COMPOSITE SPECTRAL-SENSITIVITY FUNCTIONS.

J.S.Anderson, E.A.Faulkner and D.F.Klemperer.

Austral. J. Phys., Vol. 12, No. 4, 469-70 (Dec., 1959).

In measurements of the photoelectric effect in semiconductors it is sometimes observed that the logarithm of the photoelectric emission current when plotted as a function of frequency can be regarded as the sum of two separate currents each of which fits a Fowler curve. The indentification of parameters in such situations is discussed in this paper. P.T.Landsberg

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6131 OPTICAL SENSITIZATION OF THE PHOTO-EFFECT AT THE CONTACT BETWEEN A SEMICONDUCTOR AND AN ORGANIC DYE. E.K.Putseiko.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 2, 303-6 (Nov. 11, 1959). In Russian.

The solid dye was pressed onto the semiconductor by pressures up to 5 atm. Monochromatic light in visible range, chopped at 150 c/s, and of intensity 10^{-7}-10^{-4} W cm^{-2} was used in the study. The photo-e.m.f. obtained in this way was one or two orders lower than that with an adsorbed dye (see Abstr. 4545 of 1954). Dye molecules in immediate contact with the semiconductor are responsible for the sensitization, energy being transferred from light-excited dye molecules. R.Berman

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6132 REMOVAL OF THE EDGE EFFECT IN MEASURING THE PHOTOMAGNETIC E.M.F. IN SEMICONDUCTORS. B.Ya.Moizhes.

Fiz. tverdogo Tela, Vol. 1, No. 8, 1239-42 (Aug., 1959). In Russian.

It is shown that the one dimensional formulae can be used for any width of illuminated region if the ends of the specimen are several diffusion paths and several specimen widths away from the boundaries of the region. In a weak magnetic field, if the ends are metallized the first condition alone is sufficient. R.Berman

539.2 : 537.312

6133 RELAXATION CHARACTERISTICS OF SEMICONDUCTOR PHOTO-RESISTORS AND PHOTO-ELEMENTS. F.A.Gisina.

Fiz. tverdogo Tela, Vol. 1, No. 9, 1434-40 (Sept., 1959). In Russian.

From the solution of the diffusion equations obtained by the operator method the time characteristics of photoconductivity and photo-diffusion e.m.f. were determined for semiconductors of the Ge type. Based on the results obtained, a method of determining the life-time, diffusion length and surface recombination rate is postulated. M.H.Sloboda

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6134 STUDY OF TRAPPING LEVELS IN POLYCRYSTALLINE Sb_2S_3 AND IN SINGLE CRYSTALS OF Se BY THE METHOD OF THERMO-STIMULATED CURRENT.

E.N.Arkad'eva and S.M.Ryvkin.

Fiz. tverdogo Tela, Vol. 1, No. 9, 1379-80 (Sept., 1959). In Russian.

It is shown that Se exhibits hole conductivity. Measurements are made of its photoconductivity and photosensitivity from 20° C down to −150° C. Trapping levels are found for Se at 115° K (ΔE = 0.28 eV), 165° K (ΔE = 0.34 eV), and 180° K. See also following abstract. C.R.S.Manders

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6135 STUDY OF THE TRAPPING LEVELS IN POLYCRYSTALLINE Sb_2S_3 BY THE METHOD OF THERMO-STIMULATED CURRENT. E.N.Arkad'eva and S.M.Ryvkin.

Fiz. tverdogo Tela, Vol. 1, No. 9, 1460-3 (Sept., 1959). In Russian.

Specimens cut from the crystals are furnished with aquadag electrodes and placed in glass vessels filled with He. The units are then immersed in liquid nitrogen contained in a Dewar flask. The specimen is illuminated with white or monochromatic light, then kept in the dark for some time. Next it is warmed steadily by 0.1 deg/sec from −180° to 20° C, and the thermo-stimulated current recorded. Sb_2S_3 shows three maxima of this current, the corresponding trapping levels being 0.28, 0.32 and 0.36 eV. Estimates were made of the energy states and concentrations at these levels, and of carrier lifetimes at various points over the experimental temperature range. C.R.S.Manders

539.2 : 537.312

6136 CERTAIN FEATURES OF THE PHOTOEFFECT IN AMORPHOUS FILMS OF ARSENIC TRISELENIDE.

B.T.Kolomiets and V.M.Lyubin.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 4, 789-92 (Dec. 1, 1959). In Russian.

Amorphous films of As_2Se_3 were deposited on various semi-transparent electrodes (Al, Ag, Au, Pt, SnO_2) on glass and another electrode deposited on top. The photosensitivity obtained exceeded that in Sb_2S_3 and the dark resistivity was ~10^{12} ohm-cm. The dark conductivity was found to increase exponentially with temperature with an activation energy of 1.7 eV. The photoconductivity was also found to be exponentially increasing with temperature at low temperatures, being ascribed to 0.5 eV traps, and reaching a maximum at 350° K. The sign and magnitude of the photo e.m.f. was found to vary with wavelength. It was found that the spectral distribution of the photocurrent could be divided into two classes depending on which combination of electrode materials was used and which one was illuminated; this was attributed to photodiode effects at the electrode–specimen contacts. D.J.Huntley

539.2 : 537.312

6137 PHOTOELECTROMAGNETIC EFFECT IN BISMUTH. T.Young.

Phys. Rev., Vol. 117, No. 5, 1244 (March 1, 1960).

The effect was observed for the first time in bismuth. Evaporated bismuth films as well as bulk material were shown to exhibit the effect. The dependence on the wavelength of the incident light and on the intensity of magnetic field were investigated.

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6138 PHOTOCONDUCTIVITY OF CUPROUS OXIDE IN RELATION TO ITS OTHER SEMICONDUCTING PROPERTIES. F.L.Weichman.

Phys. Rev., Vol. 117, No. 4, 998-1002 (Feb. 15, 1960).

It is shown that at least two of the three known peaks in the photoconductivity versus wavelength curve of Cu_2O are strongly dependent on the oxygen content of the material. The peak near 600 mμ can be shifted from shorter to longer wavelengths by exposing the sample to relatively low oxygen pressures at 860° C. The peak near 800 mμ is found to increase in magnitude relative to the others under these circumstances. This is in apparent contrast to the results of previous investigators. It is further shown that both results are consistent with the values of the high temperature activation energy of the conductivity process, as well as with the change in bandgap as a function of temperature as obtained from optical absorption measurements under the assumption that Cu_2O can be classified as a nonpolar semiconductor.

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6139 PHOTOELECTRONIC ANALYSIS OF HIGH RESISTIVITY CRYSTALS: (a) GaAs, (b) Sb_2S_3. R.H.Bube.

J. appl. Phys., Vol. 31, No. 2, 315-22 (Feb., 1960).

A series of photoelectronic measurements was used to obtain information about the following basic properties of high resistivity crystals: (1) majority carrier lifetime, (2) band gap, (3) activation energy for dark conductivity, and (4) activation energies and densities of trapping centres for carriers. Such measurements were made on representative high resistivity n-type crystals of GaAs and Sb_2S_3. The results are reported here together because both crystals show evidence for trapping of photoexcited carriers by compensated donor centres of the same type as those which uncompensated give rise to the normal dark conductivity. Additional data on Sb_2S_3, together with other results on similar crystals, suggest that these same uncompensated donor centres may play an important role in the recombination process.

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6140 INFRARED PROPERTIES OF GOLD IN GERMANIUM. L.Johnson and H.Levinstein.

Phys. Rev., Vol. 117, No. 5, 1191-203 (March 1, 1960).

The fundamental parameters of gold in germanium were investigated between 60-300°K by absorption, photoconductivity, and lifetime studies. Photoconductivity measurements reveal the following capture cross-sections for electrons and holes at 80°K (subscript refers to carrier being captured; superscript to charge state of gold centre): $\sigma_h^- \cong 1 \times 10^{-13}$ cm², $\sigma_e^0 \cong 6 \times 10^{-14}$ cm², $\sigma_e^- \cong 10^{-17}$ cm². Lifetime studies on n-type samples show the existence of a 0.018 eV Coulomb barrier at singly charged sites and an indication that a thermal (phonon) mechanism is involved in the electron capture process. The lifetime also manifests itself in the noise spectrum. The photoconductive absorption cross-section at 80°K of p-type gold-doped germanium (0.15 eV level) is found to be 2×10^{-18} cm² at 1.8 μ. It is suggested that differences between the absorption and photoconductive spectra are due to departure from spherical symmetry of valence band contours away from k = 0.

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6141 THE EFFECT OF SURFACE TREATMENT ON THE PHOTOCONDUCTIVITY SPECTRUM OF N-TYPE SILICON. V.A.Petrusevich.

Fiz. tverdogo Tela, Vol. 1, No. 11, 1695-6 (Nov., 1959). In Russian.

The photoconductivity spectra were obtained for n-type Si single crystals, mechanically polished (and consequently characterized by high rates of surface recombination of the photocurrent carriers, s = 10^4-10^5 cm/sec) or etched (s = 10^3-10^5 cm/sec). It was found that, similar to Ge, the photosensitivity of n-Si specimens in the high absorption (short wavelength) region decreased rapidly with increasing s. In contrast to Ge, however, non-linear effects were observed in Si even at comparatively low illumination intensities. M.H.Sloboda

539.2 : 537.312

6142 THE EFFECT OF THERMAL PRE-TREATMENT ON THE PHOTOCONDUCTIVITY OF NaCl CRYSTALS IRRADIATED WITH X-RAYS. I.Tarján, R.Voszka and Á.Somló.

Acta phys. Hungar., Vol. 11, No. 1, 59-69 (1960). In German.

The product of quantum efficiency and electron range per unit field ($\eta\omega$) was obtained at room temperature for natural and synthetic crystals irradiated with X-rays, for various concentrations of F-centres (N_F). It is found that

$$\eta\omega = 1/(A + BN_F),$$

where A and B are characteristic constants for a crystal. A and B are structure sensitive and are affected by heat treatment. J.Franks

539.2 : 537.312

6143 RECOMBINATION AND TRAPPING IN TELLURIUM. J.S.Blakemore, J.D.Heaps, K.C.Nomura and L.P.Beardsley.

Phys. Rev., Vol. 117, No. 3, 687-8 (Feb. 1, 1960).

Photoconductive decay in nearly perfect Te crystals shows a lifetime of up to 50 μsec at 300°K. The temperature dependence does not support previous suggestions of radiative recombination; at temperatures below 150°K marked trapping of excess minority electrons occurs, and at higher temperatures also the results suggest the activity of levels within the gap. Probably chemical impurities behave as recombination centres, and dislocations certainly act in this capacity (lifetime is reduced to ~ 1 μsec when 10^6 dislocations/cm² are introduced).

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6144 ELECTRICAL PROPERTIES OF ORGANIC SOLIDS. I. KINETICS AND MECHANISM OF CONDUCTIVITY OF METAL-FREE PHTHALOCYANINE. G.Tollin, D.R.Kearns and M.Calvin.

J. chem. Phys., Vol. 32, No. 4, 1013-19 (April, 1960).

Techniques involving the use of high-intensity, short-duration light pulses were applied to the study of the kinetics of photoconductivity in films of metal-free phthalocyanine. These experiments, in conjunction with measurements of steady-state photoconductivity, are consistent with the following scheme. The principle route for the formation of charge carriers is via the first excited singlet state, although the lowest triplet state can, to some extent, contribute to charge carrier production. The mobility of the carriers is low and is concentration-dependent, being lower at higher carrier concentration. The decay of the photocurrent is the result of a diffusion-limited bimolecular recombination, with a capture radius of approximately one molecular diameter. The experiments indicate that carriers produced thermally in the dark do not interact with light-produced carriers.

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6145 ELECTRICAL PROPERTIES OF ORGANIC SOLIDS. II. EFFECTS OF ADDED ELECTRON ACCEPTOR ON METAL-FREE PHTHALOCYANINE. D.R.Kearns, G.Tollin and M.Calvin.

chem. Phys., Vol. 32, No. 4, 1020-5 (April, 1960).

The addition of ortho-chloranil to the surface of films of metal-free phthalocyanine was found (a) to increase the dark conductivity of such films by as much as 10^7, (b) to increase the steady-state photoconductivity by as much as 10^5, and (c) to result in the formation of unpaired electrons whose concentration decreases reversibly as a result of illumination. These systems exhibit a light-induced polarization, the phthalocyanine layer becoming more positive with respect to the ortho-chloranil layer. Kinetic studies demonstrate that, upon illumination, a single process (time constant = 60 sec) results in the increase in conductivity, the decrease in unpaired spins and the increase in polarization. The results are consistent with the following scheme. An electron transfer from phthalocyanine to ortho-chloranil occurs in the dark at room temperature producing holes in the phthalocyanine layer and ortho-chloranil negative ion radicals (high conductivity, e.s.r. signal). Illumination results in the transfer of an electron from an excited phthalocyanine molecule to the ortho-chloranil negative ion producing further phthalocyanine holes and ortho-chloranil double negative ion (increase in conductivity, increase in polarization, decrease in e.s.r. signal). By equating spin concentration with charge carrier concentration (phthalocyanine holes) it is possible to calculate a mobility of 10^{-4} cm² V^{-1} sec^{-1} for holes in the phthalocyanine layer. With this value, a quantum yield of unity is calculated for the production of charge carriers in doped phthalocyanine. The experiments indicate a quantum yield of less than 10^{-1} for undoped phthalocyanine. The over-all results of adding a strong electron acceptor to a film of phthalocyanine are thus to (a) produce charge carriers in the dark, (b) increase the quantum yield for production of charge carriers by light and (c) increase charge carrier lifetime.

Thermoelectric Properties

539.2 : 537.32

6146 THERMOELECTRICITY AND RESISTIVITY IN METAL ALLOYS AT LOW TEMPERATURES. C.A.Domenicali.

Phys. Rev., Vol. 117, No. 4, 984-92 (Feb. 15, 1960).

A simple model is proposed for the "resonant scattering" of electrons from foreign atoms in a crystal lattice. The model assumes the existence of highly selective scattering mechanisms characterized by widths of the order of 10^{-4} eV and larger; in this sense it is similar to the model of Korringa and Gerritsen (1953), although the present model makes use of only the general analytical characteristics of the relaxation time and does not specify the details of the scattering mechanism. Mott's well-known approximation formula

$$S = (\pi^2 k^2 T/3e)[d\ln\sigma(E)/dE]_{E=E_F}$$

for the absolute thermoelectric power of a metal alloy is strictly valid and physically meaningful only at temperatures $kT \ll a$, where 2a is the width of the resonance. At temperatures $kT \gg a$ the formula leads to useful and valuable information on the thermoelectric properties of alloys, but the formula in this temperature region has

only a rather artificial physical meaning. In the intermediate temperature region where kT is comparable to a, the Mott formula is entirely invalid. But it is in precisely this intermediate temperature range that the resistance and thermoelectric anomalies occur, so that Mott's approximation cannot be used for the treatment of these anomalies. The model satisfactorily explains many of the details of this anomalous behaviour. It is suggested that the solvent metals used in the experimental studies of these effects will have to be much purer than those presently available before one can specify unambiguously the effects of a given kind of impurity.

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6147 THERMO-EMF OF CUPROUS OXIDE AT HIGH TEMPERATURES (1000° TO 1250°C). IV. K.P.Zuev.

Fiz. tverdogo Tela, Vol. 1, No. 7, 1102-11 (July, 1959). In Russian.

For Pt III, see Abstr. 1668 (1960). In this paper, the thermo-emf of Cu_2O is investigated for the first time in the temperature interval from 1000° to 1250°C, and as a function of changes in the oxygen pressure of the surrounding medium over a wide interval (press. O_2 = 1 to 760 mm Hg). It is shown that the absolute value of the thermo-emf in Cu_2O increases continuously with heating and it reaches its maximum value at the temperature which corresponds to the transition of the sample through the boundary of the stability of Cu_2O-CuO; then it falls rapidly reaching 250μ V deg^{-1} at the melting point of Cu_2O (1235°C). The transformation of Cu_2O from the solid to the liquid phase is examined. The results confirm the idea that short range order plays a decisive role. A definite relation between the curves of the dependence of the thermo-emf of Cu_2O on composition near the boundary of the stability region of Cu_2O-CuO is shown to exist, and this boundary can be accurately located by means of the experimental data. A correlation between the temperature dependence of the thermo-emf and of the electrical conductivity at high temperatures (1000°-1250°C) is established. The results of the investigation are compared and analysed from the conditions of thermodynamic equilibrium in the Cu–O_2 system. K.N.R.Taylor

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6148 THE THERMOELECTRIC PROPERTIES OF A SINGLE CRYSTAL OF MAGNETITE IN THE REGION OF THE LOW TEMPERATURE TRANSITION.

A.A.Samokhvalov and I.G.Fakidov.

Fiz. Metallov i Metallovedenie Vol. 7, No. 3, 465-7 (1959). In Russian.

The thermal e.m.f. has a sharp maximum at 95.0 ± 0.5°K; the electrical resistivity v. temperature curve bends sharply upwards at 114°K (the temperature of the known transition) and returns to its original slope at 95°K. From these results and from an analysis of the literature it is concluded that the low temperature transition is due to electron ordering, and takes place over an appreciable temperature range. A.F.Brown

539.2 : 537.32

6149 THE INFLUENCE OF PHONON DRAG OF THE CURRENT CARRIERS ON THE THERMOELECTRIC POWER OF TELLURIUM. I.N.Timchenko and S.S.Shalyt.

Fiz. tverdogo Tela, Vol. 1, No. 8, 1302-4 (Aug., 1959). In Russian.

The thermoelectric power of tellurium was measured from 2-300°K. Above the maximum at T°K the phonon drag component decreases as $T^{-2.7}$ and below the maximum as $T^{0.7}$ in good agreement with Herring's theory. D.J.Huntley

Dielectric Properties

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6150 GROWTH OF FERROELECTRIC HYSTERESIS LOOPS. J.C.Burfoot and R.V.Peacock.

Proc. Phys. Soc., Vol. 73, Pt 6, 973-5 (June, 1959).

The phenomenon described is a growth in the saturation polarization of c-domain $BaTiO_3$ crystals during switching with a sinusoidal voltage, the polarization going from 3 to 25 $\mu c/cm^2$ in about 5 hours. The hysteresis loops remain flat-topped throughout this time. Various explanations are considered, and in conjunction with observations of the etch pattern on partly switched crystals one of these is singled out as most plausible. K.W.Plessner

539.2 : 537.2

6151 PERMITTIVITY OF MIXTURES OF ZINC OXIDE AND RUBBER. N.H.Langton and D. Matthews.

Brit. J. appl. Phys., Vol. 10, No. 7, 306-9 (July, 1959).

Measured values are given for the permittivities of a number of zinc oxide rubber mixes at frequencies of 0.1, 1.0, and 10.0 Mc/s. The zinc oxide was of known particle size and shape, and the particle distribution in the rubber was examined with an electron microscope. The measured permittivities are compared with those calculated from the equations of Lichteneker, (1926) Weiner 1913 and Bruggeman 1935. Values of Weiner's form factor are also calculated. It is shown that whilst the equations of Weiner and Bruggeman give satisfactory agreement, Lichteneker's equation gives permittivity values which are too low.

539.2 : 537.2

6152 ELECTRIC PROPERTIES OF THE ALUMINOSILICATE, BOROSILICATE AND ALUMINO-BOROSILICATE GLASSES. A.A.Appen and Gan' Fu-si [Kang Fu-Si].

Fiz. tverdogo Tela, Vol. 1, No. 10, 1529-37 (Oct., 1959). In Russian.

The dependence of the dielectric loss (tan δ) and permittivity (ϵ) of the glasses on their chemical composition was investigated at 10^3 and 10^6 c/s and room temperature; tan δ/temperature dependence was investigated in the interval 60-300°K and the tan δ/frequency dependence between 10^3 and 10^7 c/s. Molar substitution of Al_2O_3 for SiO_2 brought about the increase of both tan δ and conductance. The effect of suppression and the aluminoboric anomaly were not detected in tan δ or κ. The substitution of Al_2O_3 for SiO_2 also caused an increase of ϵ; however, in some cases (with B_2O_3 content) a decrease of ϵ and the aluminoboric anomaly were detected. Molar substitution of B_2O_3 for SiO_2 caused maxima (boric anomaly) on the ϵ curve. F.Lachman

539.2 : 537.2

6153 THE DIELECTRIC PROPERTIES OF ROSIN. A.K.Sen and G.N.Bhattacharya.

Indian J. Phys., Vol. 32, No. 12, 556-65 (Dec., 1958).

The dielectric properties of "water white" rosin have been measured over a wide range of temperature and frequency, viz., from 20°C to 150°C and from 1 kc/s to 500 kc/s. Within the temperature range of investigation rosin behaves as a typical polar resin in the anamalous dispersion range. The range of dispersion is wide and this may be explained from the distributed relaxation times of its polar units. With the help of melt viscosity data on this resin the size of its rotating unit has been calculated following Debye's relations and the calculated radius comes out to be 4.6 A.

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6154 FERROELECTRIC PROPERTIES OF SOLID SOLUTIONS IN THE SYSTEM $PbNb_2O_6$–$BaNb_2O_6$–$SrNb_2O_6$. G.A.Smolenskii, V.A.Isupov and A.I.Agranovskaya.

Fiz. tverdogo Tela, Vol. 1, No. 3, 442-9 (March, 1959). In Russian.

Deals with ferroelectric and piezoelectric properties of solid solutions of $BaNb_2O_6$ and $SrNb_2O_6$ in lead metaniobate ($PbNb_2O_6$). The Curie temperature of (Pb, Sr)Nb_2O_6 solid solutions was found to decrease monotonically with increase of the amount of strontium-metaniobate. The Curie temperature of (Pb, Ba)Nb_2O_6 solutions fell first with increase of the amount of barium metaniobate, but it rose above 40 mol.% $BaNb_2O_6$. In all solid solutions a flat maximum of tan δ between 0 and 100°C and a minimum between 100 and 200°C were observed. In $Pb_{0.5}Ba_xSr_{0.5-x}Nb_2O_6$ samples a new permittivity maximum appeared at 200-240°C on decrease of x. Samples with compositions given by x = 0.05, 0.075 and 0.10 had high permittivities (about 3500), which were practically constant between −60 and 240°C. Solid solutions based on lead metaniobate had good piezoelectric properties in a wide range of temperatures. A.Tybulewicz

539.2 : 537.2

6155 FERROELECTRICITY IN TETRAMETHYLAMMONIUM-TRICHLORO-MERCURATE. E.Fatuzzo and R.Nitsche.

Phys. Rev., Vol. 117, No. 4, 936 (Feb. 15, 1960).

$[N(CH_3)_4]\cdot HgCl_3$ is ferroelectric between −80° and +200°C. Above 200°C it decomposes without showing a Curie point. At room temperature the spontaneous polarization is about 1.2 $\mu C/cm^2$, the coercive field 3 keV/cm and the dielectric constant 60.

539.2 : 537.2

6156 EFFECTS ON THE PROPERTIES OF A BARIUM TITANATE OF ADDING METALLIC OXIDES. G.Lapluye, G.Morinet and P.Palla.

C.R. Acad. Sci. (Paris), Vol. 250, No. 2, 305-7 (Jan. 11, 1960). In French.

Oxides of La, W and Mo were added to a $BaTiO_3$ containing 5% excess TiO_2. As the amount of additive is increased, maxima and minima are produced in the permittivity and loss tangent at room temperature and in the permittivity at the Curie temperature. R.C.Kell

539.2 : 537.2 : 621.315.612.4

6157 DETAILED STUDY OF SWITCHING CURRENT IN BARIUM TITANATE. M.E.Drougard.

J. appl. Phys., Vol. 31, No. 2, 352-5 (Feb., 1960).

The polarization reversal process in ferroelectrics has, up to now, been characterized solely by the total switching time and the maximum value of the switching current. The present work was aimed at determining how the instantaneous value of the switching current in single crystals of $BaTiO_3$ depends on the applied field, the state of net polarization of the crystal, and possibly other factors. It was found that the switching current density can be expressed as the product of a function of the polarization, $\phi(p)$, and a function of the electric field, $\exp(-\alpha/E)$. The form of the function $\phi(p)$ indicates a predominance of sideways expansion of 180° domains, with an exponentially increasing domain wall velocity. This last result is shown to be in agreement with a picture of domain wall motion by nucleation of new domain wall layers. This interpretation, together with some details of the switching current pattern, suggests that a crystal, although apparently single-domain, may always retain some small domains of opposite polarization.

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DOMAIN PATTERNS OF THE LOW-TEMPERATURE PHASE OF BARIUM TITANATE. See Abstr. 4583

539.2 : 537.2 : 535.37

6158 STUDY OF THE PHOTODIELECTRIC PHENOMENON IN LUMINESCING ZINC CADMIUM SULPHIDES. I.Soudek.

Czech. J. Phys., Vol. 9, No. 5, 590-6 (1959). In German.

Powder layers of ZnS and ZnCdS without binder were used to measure the spectral distribution of excitation, of luminescence, and of the alteration under irradiation of the real component of the dielectric constant ϵ' and of the dielectric loss. A trace of Cu insufficient to evoke its characteristic luminescence in the phosphors can cause an alteration in ϵ'. The spectral maximum of $\Delta\epsilon'$ agrees with the excitation maximum. S.T.Henderson

539.2 : 537.2

6159 ON THE MAKING OF ELECTRET AND MEASUREMENT OF THE CHANGES OF DIELECTRIC CONSTANT OF A POLARISED ELECTRET FORMING MATERIAL WITH TIME. T.C.Bhadra.

Indian J. Phys., Vol. 32, No. 6, 281-96 (June, 1958).

Electrets were made with commercially available carnauba wax and the influence of voltage and temperature on their formation were studied. Attempts were made to measure the surface charges with an electrometer and variations with time of the dielectric constant ϵ and tan δ were also measured. On application of the field in the molten condition of the material, only a fraction of the dipoles orient in the direction of the field, a larger portion orient randomly in all other possible directions. Alignments of the dipoles in the parallel direction increases the dielectric constant. More of the dipoles orient in the parallel direction with time due to the field induced by the dipoles, thereby increasing the value of dielectric constant. In the present investigation, abnormally high increase in the value of dielectric constant along the direction of the field was obtained. When the dielectric constant was measured at right angles to the direction of the field, the values of the treated material were found to be lower than those for the control sample. A.C. conductivity of the material was calculated from the measured values of ϵ and tan δ.

539.2 : 537.2

6160 PYROELECTRICITY, INTERNAL DOMAINS, AND INTERFACE CHARGES IN TRIGLYCINE SULFATE. A.G.Chynoweth.

Phys. Rev., Vol. 117, No. 5, 1235-43 (March 1, 1960).

Using the dynamic pyroelectric technique, the spontaneous polarization of triglycine sulphate was determined between the Curie point and −140° C. No evidence of any phase transitions over this temperature range was found (other than the Curie point). The polarization could still be reversed by an applied field, though slowly, at the lowest temperatures attained. In the paraelectric region above the Curie point, the pyroelectric behaviour shows some deviations at low applied fields from the predictions of Devonshire's theory (Abstr. 956 of 1950). The cause of these deviations is not known but they may be due to uniform conditions, either mechanical or electrical, in the crystal. With no field applied to the crystal, pyroelectrical signals can be generated temporarily above the Curie point. These are ascribed mainly to polarizations induced by the compensation charges, while they last, which accumulate around residual domains that cannot be removed by the poling field at room temperature. These residual domains have been delineated using powder pattern and etching techniques and are revealed as long thin domains, pointed at both ends and lying along the ferroelectric direction, either in the interior of the crystal or intercepting the surfaces. The causes of these persistent domains are not known. It is found that on cooling a crystal through the Curie point, there is a strong tendency for it to repolarize with the same polarity it had previously. This phenomena is ascribed to the presence of ferroelectrically inactive surface layers giving rise to interface charges.

539.2 : 537.2

RESPONSE OF PERFECT INSULATOR TO LONG E.M. WAVES. See Abstr. 5260

OPTICAL PROPERTIES OF SOLIDS

539.2 : 535

6161 SOME OPTICAL PROPERTIES OF SINGLE MICROCRYSTALS. G.Gergely.

Acta phys. Hungar., Vol. 7, No. 1, 1-24 (1957).

A photoelectric microscope photometer was built for the investigation of the absorption, emission and reflection of single microcrystals. It consists of a Zeiss microscope, a mercury lamp and a multiplier phototube. The transmission of single microcrystals was examined. On evaluating the experimental data, neither a plane-parallel, nor a spherical crystal model, furnished reliable values for the absorption coefficient. The application of an empirical model based on the non-absorbed radiation made possible the determination of the 3650 A absorption coefficient. The absorption coefficients of some ZnS-type materials were determined. The 3650 A absorption coefficients have the following values: hex. ZnS : Ag, 124/cm; cub. ZnS : Ag, 139/cm; hex. ZnS : Cu, 220/cm; hex. ZnS, 57 3/cm; ZnS−10CdS : Cu, 292/cm; 50ZnS−50CdS : Ag, 636/cm. The light emission of microcrystals increases with the second power of the diameter. It depends on the light path of ultraviolet radiation within the crystals. The ultraviolet absorption coefficient may be determined from the dependence of the emission on the particle size. The refractive index of microcrystals can be determined from microscopic reflection measurements.

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6162 FORMATION OF POLARONS ON ABSORPTION OF LIGHT IN CRYSTALS. E.F.Gross and I.Pastrnyak.

Fiz. tverdogo Tela, Vol. 1, No. 3, 518-21 (March, 1959). In Russian.

The two-step structure of the fundamental absorption edge of Cu_2O crystals is used to show that polarons can be formed by direct optical transitions of electrons from the valence band to polaron states (below the bottom of the conduction band). A.Tybulewicz

539.2 : 535

6163 A THEORY OF OPTICAL PROPERTIES OF ELECTRON SEMICONDUCTORS IN THE INFRARED SPECTRAL REGION. V.I.Cherepanov.

Fiz. tverdogo Tela, Vol. 1, No. 7, 1035-43 (July, 1959). In Russian.

On the basis of the classical theory of free electrons, the interaction of infrared electromagnetic waves with the conductivity electrons of an electron semiconductor was examined. The basic differential equation for the electric vector of an electromagnetic wave under the conditions of normal character of skin effect in a semiconductor was derived. The solution of this equation and the surface impedance were found. General dispersion formulae for the optical constants of non-degenerate semiconductors with arbitrary dependence of the mean free time τ on the electron velocity v were found. An obvious form of these formulae for homopolar semiconductors for which $\tau = lv^{-1}$ was found. The results are compared with the classical theory of Drude−Zener−Kronig for metals. D.J.Huntley

539.2 : 535

6164 OPTICAL PROPERTIES OF SiC IN INFRARED REGION. M.Namba.

J. Phys. Soc. Japan, Vol. 14, No. 2, 228-9 (Feb., 1959).

Measurements of reflection and transmission from 2.5 to 16 μ were made on n- and p-type samples about 0.15 mm thick. Only the n-type sample, with a resistivity of 100 ohm cm, showed free

carrier absorption. Both samples had an impurity absorption at 4.3 μ and an intense lattice absorption at 12 μ. The reflection spectrum in the range from 8 to 14 μ indicated that the bonding in the crystal was partly ionic, with values of 5.1 and 7 for the high frequency and static dielectric constants. C.Hilsum

539.2 : 535 : 537.3

6165 THE RELATIONSHIP BETWEEN THE OPTICAL CONSTANTS OF METALS AND THEIR MICROCHARACTERISTICS. G.P.Motulevich.
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1770-4 (Dec., 1959). In Russian.

Relationship between the optical characteristics of metals and their microscopic characteristics is considered. It is shown that measurement of the optical constants of metals in the infrared region over a large wavelength range in conjunction with measurements of the static conductivity of the same samples at various temperatures should permit one to determine the density of conduction electrons, electron velocity on the Fermi surface and frequency of interelectronic collisions. A procedure for treatment of the experimental data is suggested which takes into account recent theoretical results.

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539.2 : 535

6168 NEW DATA ON THE ANOMALOUS DISPERSION OF MAGNESIUM PLATINOCYANIDE. C.Moncuit.
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6175 THE THEORY OF ABSORPTION OF LIGHT BY IMPURITIES IN HOMOPOLAR CRYSTALS.
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6176 AN EXPERIMENTAL PROOF OF THE EXISTENCE OF ADDITIONAL ANOMALOUS LIGHT WAVES IN CRYSTALS IN THE EXCITON ABSORPTION REGION.
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6177 INVESTIGATION OF INFRARED ABSORPTION IN ALKALI HALIDE CRYSTALS WITH ANIONIC IMPURITIES. W.Wardzyński.
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539.2 : 535.33

6180 EXPERIMENTAL STUDY OF THE SHAPE OF THE F-BAND ABSORPTION IN KCl. J.D.Konitzer and J.J.Markham.

J. chem. Phys., Vol. 32, No. 3, 843-56 (March, 1960).

The optical absorption due to F centres in KCl at temperatures between 4°K and 377°K was measured. The authors believe they have eliminated the K band, and obtained the absorption due to transitions from the ground to the first excited state. The method of preparing "pure" F centres is discussed. The half-width, the point of maximum absorption, and the zeroth, first and second moments were measured in the above temperature range. The data establish Smakula's formula on a firm experimental basis for this centre. The half-width in eV is given by the relation $0.163[\coth(71.0/\theta)]^{1/2}$, while the point of maximum absorption is at $2.340-0.027\coth(71.0/\theta)$, where θ is the absolute temperature. An equation has been found from which one may calculate the F band absorption. The shape of the band is temperature independent and is approximated by the low temperature form predicted by Pekar. The data on the whole support a generalized theory. The authors believe that the F band shape is due to the interaction of the F electron with localized modes whose average ground state frequency is $2.96 \times 10^{13}\ \text{sec}^{-1}$.

539.2 : 535.33

6181 ABSOLUTE INFRARED INTENSITIES OF THE AMMONIUM ION IN CRYSTALS. C.C.Ferriso and D.F.Hornig.

J. chem. Phys., Vol. 32, No. 4, 1240-5 (April, 1960).

The absolute intensities of the two infrared active fundamentals of the ammonium ion, ν_3 and ν_4, were studied in several environments. Dilute solid solutions of NH_4^+ ions in KCl, KI, CsCl, and CsI were studied and compared with pure NH_4I. After separating the effect of the net charge, the apparent bond moments ranged from 0.63 to 0.80 d (av. 0.71) and the bond dipole derivatives, $\partial\mu/\partial r$, from 2.06 d/A to 3.59 d/A (av. 2.80 d/A). The bond moment is substantially the same as in NH_3.

539.2 : 535.33

6182 OPTICAL PROPERTIES OF LITHIUM FLUORIDE IN THE INFRARED. M.Gottlieb.

J. Opt. Soc. Amer., Vol. 50, No. 4, 343-9 (April, 1960).

Reflectivity measurements were performed on lithium fluoride single crystals at 135° K, 210° K, 300° K, and 355° K at wavelengths from 2 μ to 60 μ. A Perkin–Elmer 112 prism monochromator was used between 2 μ and 30 μ and was modified to a grating monochromator for use between 30 μ and 60 μ. The reflection band near the reststrahl peak shows pronounced secondary structure. A Kramers–Kronig dispersion relation was applied to the Fresnel reflection formula, and the secondary structure was exhibited in the optical constants. The analysis was performed on an IBM-704 computer, and the phase of the reflectivity was determined at some 400 points in the 2 μ to 60 μ range. For each of these points, the real and imaginary dielectric constants, the index of refraction, the extinction coefficient, and the absorption constant were determined. In addition to the main peak of the imaginary dielectric constant at 312.5 cm^{-1}, two secondary peaks appeared on the short wavelength side of the maximum. One was at 485 cm^{-1} and became sharper at higher temperature; the other was at 650 cm^{-1} and was relatively insensitive to temperature over the range measured. An interpretation based on the coupling of the fundamental longitudinal mode to the radiation field is discussed. The damping constants of the main peak were evaluated and were found to vary linearly with temperature over the range measured.

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6183 REFLECTIVITY OF Li^6F AND Li^7F. M.Gottlieb.

J. Opt. Soc. Amer., Vol. 50, No. 4, 350-1 (April, 1960).

Reflectivity measurements were performed on films of Li^6F and Li^7F. The films were deposited onto substrates of natural lithium fluoride crystals by vacuum evaporation. Typical film thickness was 10 μ. Because the lattice constants of the pure isotope material and the natural crystal differ by less than 0.03%, the crystallinity of the films was good. It was found that the fundamental optical mode frequency is proportional to the square root of the reduced mass, as predicted from the simple model of an ionic crystal.

539.2 : 535.33

6184 INFRARED ABSORPTION IN n-TYPE ALUMINUM ANTIMONIDE. W.J.Turner and W.E.Reese.

Phys. Rev., Vol. 117, No. 4, 1003-4 (Feb. 15, 1960).

The optical absorption constants of tellurium and selenium doped n-type AlSb were determined in the spectral region 0.7-38 μ at 300° and 78° K. A 4.3 μ band exists at 300° K for which the absorption constant varies linearly with electron concentration. This band may be explained by a 0.3 eV spin–orbit split-off conduction band or alternatively by a multivalleyed conduction band with a central minimum 0.3 eV above the lowest minima. A transition from the highest valence bands to the lowest conduction level could account for the observed absorption starting at 1.33 eV. At wavelengths greater than 8-10 μ free-carrier absorption exists with a λ^2 dependence and a calculated effective mass of 0.3 m. Lattice bands are present at 11.2, 13.5, 16.5, 22.9, 27.8 and 29.8 μ.

539.2 : 535.33

6185 THE REFLECTION SPECTRUM OF CdS. A.Lempicki.

Proc. Phys. Soc., Vol. 74, Pt 1, 138-9 (July 1, 1959).

The spectrum was measured from 4700 to 5000 A with the crystal at liquid nitrogen temperature. Absorption lines were located at 4874, 4844 and 4731 A. The results are interpreted in terms of direct transitions from three valence bands to a single conduction band. C.Hilsum

539.2 : 535.33

6186 OPTICAL OBSERVATION OF EXCHANGE SPLITTING IN YTTERBIUM IRON GARNET. K.A.Wickersheim and R.L.White.

Phys. Rev. Letters, Vol. 4, No. 3, 123-5 (Feb. 1, 1960).

In contrast to the case of ytterbium aluminium garnet the ytterbium iron garnet shows a splitting of absorption spectra in the 9700 A region ($^2F_{7/2} \rightarrow {}^2F_{5/2}$ of Yb^{3+} ion) even with medium resolution instruments. This is attributed to splitting of the degenerate Yb^{3+} ion levels by the exchange field due to the neighbouring Fe^{3+} ions. The splitting shows marked anisotropy effects in externally applied magnetic fields. G.F.J.Garlick

539.2 : 535.37

6187 CRYSTAL LUMINESCENCE [Luminescence crystalline]. D.Curie.

Paris: Dunod (1960) ix + 209 pp. [Monographies Dunod]. In French.

The book is one of a series of monographs for students. It presents a useful collection of data on luminescence together with relevant theories. Special attention is paid to theory for specific types of emission centre, e.g. KCl:Tl and to energy storage and

carrier absorption. Both samples had an impurity absorption at 4.3 μ and an intense lattice absorption at 12 μ. The reflection spectrum in the range from 8 to 14 μ indicated that the bonding in the crystal was partly ionic, with values of 5.1 and 7 for the high frequency and static dielectric constants. C.Hilsum

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6180 EXPERIMENTAL STUDY OF THE SHAPE OF THE F-BAND ABSORPTION IN KCl. J.D.Konitzer and J.J.Markham.

J. chem. Phys., Vol. 32, No. 3, 843-56 (March, 1960).

The optical absorption due to F centres in KCl at temperatures between 4°K and 377°K was measured. The authors believe they have eliminated the K band, and obtained the absorption due to transitions from the ground to the first excited state. The method of preparing "pure" F centres is discussed. The half-width, the point of maximum absorption, and the zeroth, first and second moments were measured in the above temperature range. The data establish Smakula's formula on a firm experimental basis for this centre. The half-width in eV is given by the relation $0.163[\coth(71.0/\theta)]^{1/2}$, while the point of maximum absorption is at $2.340-0.027\coth(71.0/\theta)$, where θ is the absolute temperature. An equation has been found from which one may calculate the F band absorption. The shape of the band is temperature independent and is approximated by the low temperature form predicted by Pekar. The data on the whole support a generalized theory. The authors believe that the F band shape is due to the interaction of the F electron with localized modes whose average ground state frequency is $2.96 \times 10^{13}\ \text{sec}^{-1}$.

539.2 : 535.33

6181 ABSOLUTE INFRARED INTENSITIES OF THE AMMONIUM ION IN CRYSTALS. C.C.Ferriso and D.F.Hornig.

J. chem. Phys., Vol. 32, No. 4, 1240-5 (April, 1960).

The absolute intensities of the two infrared active fundamentals of the ammonium ion, ν_3 and ν_4, were studied in several environments. Dilute solid solutions of NH_4^+ ions in KCl, KI, CsCl, and CsI were studied and compared with pure NH_4I. After separating the effect of the net charge, the apparent bond moments ranged from 0.63 to 0.80 d (av. 0.71) and the bond dipole derivatives, $\partial\mu/\partial r$, from 2.06 d/A to 3.59 d/A (av. 2.80 d/A). The bond moment is substantially the same as in NH_3.

539.2 : 535.33

6182 OPTICAL PROPERTIES OF LITHIUM FLUORIDE IN THE INFRARED. M.Gottlieb.

J. Opt. Soc. Amer., Vol. 50, No. 4, 343-9 (April, 1960).

Reflectivity measurements were performed on lithium fluoride single crystals at 135° K, 210° K, 300° K, and 355° K at wavelengths from 2 μ to 60 μ. A Perkin–Elmer 112 prism monochromator was used between 2 μ and 30 μ and was modified to a grating monochromator for use between 30 μ and 60 μ. The reflection band near the reststrahl peak shows pronounced secondary structure. A Kramers–Kronig dispersion relation was applied to the Fresnel reflection formula, and the secondary structure was exhibited in the optical constants. The analysis was performed on an IBM-704 computer, and the phase of the reflectivity was determined at some 400 points in the 2 μ to 60 μ range. For each of these points, the real and imaginary dielectric constants, the index of refraction, the extinction coefficient, and the absorption constant were determined. In addition to the main peak of the imaginary dielectric constant at 312.5 cm^{-1}, two secondary peaks appeared on the short wavelength side of the maximum. One was at 485 cm^{-1} and became sharper at higher temperature; the other was at 650 cm^{-1} and was relatively insensitive to temperature over the range measured. An interpretation based on the coupling of the fundamental longitudinal mode to the radiation field is discussed. The damping constants of the main peak were evaluated and were found to vary linearly with temperature over the range measured.

539.2 : 535.33

6183 REFLECTIVITY OF Li^6F AND Li^7F. M.Gottlieb.

J. Opt. Soc. Amer., Vol. 50, No. 4, 350-1 (April, 1960).

Reflectivity measurements were performed on films of Li^6F and Li^7F. The films were deposited onto substrates of natural lithium fluoride crystals by vacuum evaporation. Typical film thickness was 10 μ. Because the lattice constants of the pure isotope material and the natural crystal differ by less than 0.03%, the crystallinity of the films was good. It was found that the fundamental optical mode frequency is proportional to the square root of the reduced mass, as predicted from the simple model of an ionic crystal.

539.2 : 535.33

6184 INFRARED ABSORPTION IN n-TYPE ALUMINUM ANTIMONIDE. W.J.Turner and W.E.Reese.

Phys. Rev., Vol. 117, No. 4, 1003-4 (Feb. 15, 1960).

The optical absorption constants of tellurium and selenium doped n-type AlSb were determined in the spectral region 0.7-38 μ at 300° and 78° K. A 4.3 μ band exists at 300° K for which the absorption constant varies linearly with electron concentration. This band may be explained by a 0.3 eV spin–orbit split-off conduction band or alternatively by a multivalleyed conduction band with a central minimum 0.3 eV above the lowest minima. A transition from the highest valence bands to the lowest conduction level could account for the observed absorption starting at 1.33 eV. At wavelengths greater than 8-10 μ free-carrier absorption exists with a λ^r dependence and a calculated effective mass of 0.3 m. Lattice bands are present at 11.2, 13.5, 16.5, 22.9, 27.8 and 29.8 μ.

539.2 : 535.33

6185 THE REFLECTION SPECTRUM OF CdS. A.Lempicki.

Proc. Phys. Soc., Vol. 74, Pt 1, 138-9 (July 1, 1959).

The spectrum was measured from 4700 to 5000 A with the crystal at liquid nitrogen temperature. Absorption lines were located at 4874, 4844 and 4731 A. The results are interpreted in terms of direct transitions from three valence bands to a single conduction band. C.Hilsum

539.2 : 535.33

6186 OPTICAL OBSERVATION OF EXCHANGE SPLITTING IN YTTERBIUM IRON GARNET. K.A.Wickersheim and R.L.White.

Phys. Rev. Letters, Vol. 4, No. 3, 123-5 (Feb. 1, 1960).

In contrast to the case of ytterbium aluminium garnet the ytterbium iron garnet shows a splitting of absorption spectra in the 9700 A region ($^2F_{7/2} \rightarrow {}^2F_{5/2}$ of Yb^{3+} ion) even with medium resolution instruments. This is attributed to splitting of the degenerate Yb^{3+} ion levels by the exchange field due to the neighbouring Fe^{3+} ions. The splitting shows marked anisotropy effects in externally applied magnetic fields. G.F.J.Garlick

539.2 : 535.37

6187 CRYSTAL LUMINESCENCE [Luminescence crystalline]. D.Curie.

Paris: Dunod (1960) ix + 209 pp. [Monographies Dunod]. In French.

The book is one of a series of monographs for students. It presents a useful collection of data on luminescence together with relevant theories. Special attention is paid to theory for specific types of emission centre, e.g. KCl:Tl and to energy storage and

transfer in photoconducting phosphors. Thermal and optical activation processes for trapped electrons are considered and a final chapter deals with fluorescence sensitization. A short bibliography is included but no indexes are provided. G.F.J.Garlick

539.2 : 535.37 : 537.311 : 621.315.59 : 621.382

SEMICONDUCTORS AND PHOSPHORS [Halbleiter und Phosphore]. See Abstr. 4324

539.2 : 535.37

6188 SIMPLE APPARATUS FOR THE MEASUREMENT OF THE EMISSION OF LUMINESCENT POWDERS, EXCITABLE BY U.V. M.Legrand, A.Lacam and M.Grosjean.
J. Phys. Radium, Vol. 18, Suppl. No. 12, 131A-134A (Dec., 1957). In French.

The apparatus allows relative measurement of the spectral energy distribution, between 2000 and 8000 A, of the light emitted by phosphors, excitable by u.v. or visible radiations. It also allows the diffuse reflection curves for the same wavelength region to be drawn. The adaptation of the apparatus for use with the Beckman D.U. spectrophotometers is very easy and does not necessitate optical adjustment.

539.2 : 535.37

6189 ON THE WIDE DISTRIBUTION OF A BLUISH FLUORESCENCE OF ORGANIC ORIGIN. K.Przibram.
Naturwissenschaften, Vol. 46, No. 24, 666 (1959). In German.

Many materials which have been ignited to destroy their luminescence, exposed to air and rewarmed, show a greenish-blue fluorescence attributed to the absorption of organic matter in dust from the air. A similar fluorescence, destroyed by ignition, is also found on freshly cleaved surfaces of minerals. S.T.Henderson

539.2 : 535.37

6190 CHARACTERISATION OF THE TEMPERATURE QUENCHING OF INORGANIC CRYSTAL PHOSPHORS BY MEANS OF EXPERIMENTALLY ACCESSIBLE PARAMETERS.
H.Witzmann and J.Buhrow.
Z. phys. Chem. (Leipzig), Vol. 212, No. 5-6, 279-94 (1959). In German.

The equation, $I/I_0 = \{1 + C \exp -W/kT\}^{-1}$ for fluorescence efficiency, reduces at higher temperatures to a linear relation between log efficiency and 1/T, and previously published data for several phosphors are given graphically to confirm this. From the linear part of the curves W and C can be determined. It is further shown that the temperature of steepest fall of emission, T_a, is nearly equal to $W/k(A\log C + B)$, where A and B are numerical constants arising in the approximation. Calculated values of T_a agree within 20°C with published experimental values. W has the predominant effect on T_a but examples are given where C is important. The effects on W and C of activator content and other additions in orthophosphate and arsenate phosphors are discussed. S.T.Henderson

539.2 : 535.37

6191 THE EMISSION PROPERTIES OF LEAD-ACTIVATED ALKALINE-EARTH BORATES WITH REFERENCE TO THE BASE LATTICE TYPE AND ACTIVATOR CONCENTRATION.
H.Witzmann and W.Treichler.
Z. phys. Chem. (Leipzig), Vol. 212, No. 3-4, 205-21 (1959). In German.

The ultraviolet fluorescence spectra of the alkaline-earth borates were investigated in the region 250-400 mμ. The lead content was varied from 10^{-3} to 10^{-1} g Pb per g borate for the borates of Sr and fixed at 10^{-2} for those of Be, Mg, Ca, and Ba. In all cases except for Ba, two separate emission regions were observed and it was found that increase of the B_2O_3 content considerably strengthened the shorter wavelength emission. It is concluded that the actual band positions are independent of the lead content, but do depend on the base lattice. Many diagrams are given of the results. Attention is drawn to the possible use of the phosphors in erythemy. P.A.Young

539.2 : 535.37

6192 THE LUMINESCENCE, COLORATION AND EXO-ELECTRON EMISSION OF CaF_2 CRYSTALS COLOURED BY DIFFERENT METHODS.
J.Dolejší, J.Kantůrek, A.Bohun and J.Trnka.
Czech. J. Phys., Vol. 8, No. 5, 548-56 (1958). In German.

Crystals from various sources, natural and synthetic, coloured by different processes all show characteristic thermoemission maxima at 370, 480 and 650°K corresponding to absorption maxima at 5800, 5200 and 3600 A. The luminescence emission spectrum during warming is influenced by impurities, in particular the emission peak at 3850 A can be ascribed to copper. G.F.J.Garlick

539.2 : 535.37

6193 VISIBLE EMISSION OF NICKEL-ACTIVATED CaS. M.Avinor.
J. chem. Phys., Vol. 32, No. 2, 621-2 (Feb., 1960).

CaS:Ni has a weak greenish-yellow fluorescence, and CaS:Cu shows an emission band with peak near 4900 A. Cu and Ni together produce a red emission band (peak ~ 6800 A) at room temperature, while at liquid N_2 temperature this band remains with another at 5850 A. It is suggested that Ni^{3+} is responsible. S.T.Henderson

539.2 : 535.37

6194 EXTREME VARIATIONS OF THE EMISSION SPECTRA OF DYSPROSIUM CHELATES.
G.A.Crosby and R.E.Whan.
J. chem. Phys., Vol. 32, No. 2, 614-15 (Feb., 1960).

Consideration of the excited electronic states of the molecules of chelates of Dy^{3+} and Tb^{3+} suggests some explanation for the different emission observed in the luminescence spectra of rare earth chelates. G.I.W.Llewelyn

539.2 : 535.37

6195 LUMINESCENCE OF SOLID NITROGEN(4.2°K) CONTAINING FREE ATOMS OR RADICALS. EFFECT OF DILUTION WITH ARGON. H.P.Broida and M.Peyron.
J. Phys. Radium, Vol. 18, No.10, 593-5 (Oct., 1957). In French.

The products obtained from a microwave discharge in pure or argon diluted nitrogen are rapidly frozen on a glass surface kept at liquid helium temperature. The spectoscopical features are described. They show some evidence that metastable atoms are trapped in the solid and are able to radiate. Some molecular spectra are probably formed as a consequence of a recombination in the solid. The dilution by argon affects the solid lattice and, consequently, the spectrum becomes quite different. In particular, new band systems appear and some lines are shifted with important modification in their structure.

539.2 : 535.37

6196 EMISSION SPECTRA OF TRIVALENT TERBIUM.
L.G.Van Uitert and R.R.Soden.
J. chem. Phys., Vol. 32, No. 4, 1161-4 (April, 1960).

The luminescent emission spectra of the members of the series $Y_{1-x}Tb_x$ antipyrene $_3I_3$ and $Ca_{1-2x}Na_xTb_x$ WO_4 were measured and compared. The antipyrene complexes show spectra similar to that for terbium octahydrosulphate which is a simple inverted multiplet. The tungstate spectra results from emission originating from two electronic levels. The relative intensities of the emissions from these two states are dependent upon the terbium concentration. In $Na_{0.5}Tb_{0.5}WO_4$ the usual spectral bands are by far the stronger. In $CaWO_4:Tb_{0.0001}$ the situation is reversed.

539.2 : 535.37

6197 ON DEEP TRAPPING STATES IN ZnS PHOSPHORS. K.S.K.Rebane.
Optika i Spektrosk., Vol. 4, No. 2, 211-16 (Feb., 1958). In Russian. English summary: PB141047T-1, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

Deep traps in ZnS activated by various impurities were studied ZnS:Cu:$MgCl_2$, ZnS:ZnO:Cu, ZnS:Cu:Te and ZnS:Cu:Ni. Slow rise of fluorescence with time under weak excitation at room temperature and after previous heating procedures revealed deep traps emptied at 110 and 190°C. The first group can be found in thermoluminescence for some phosphors. 800 mμ light empties the "190°C" traps. Visible light down to 485 mμ stimulates the phosphorescence with a maximum at 563 mμ. G.F.J.Garlick

539.2 : 535.37

6198 ON THE PARALLELISM BETWEEN IONIZATION AND LUMINESCENCE IN CRYSTALS OF SALTS OF QUININE AND QUINIDINE BY HYDRATION AND DEHYDRATION.
D.M.Kiritch and D.K.Yovanovitch.
C.R. Acad. Sci. (Paris), Vol. 250, No. 1, 103-5 (Jan. 4, 1960). In French.

Luminescence and ionization of the salts occurred simultaneously on varying the temperature. It is suggested that electrical discharges occur when water ions are lost or absorbed. J.Franks

539.2 : 535.37

6199 ABSORPTION AND FLUORESCENCE SPECTRA OF RADICALS OBTAINED BY HIGH FREQUENCY DISCHARGE IN SOME AROMATIC VAPOURS, AND FIXED AT LOW TEMPERATURE. Y.Lortie.
J. Phys. Radium, Vol. 18, No. 8-9, 520-2 (Aug. - Sept., 1957). In French.

The study of u.v. and visible absorption spectra and of fluorescence spectra of the radicals produced by a h.f. discharge in toluene, ethylbenzene and benzylamine vapours, fixed as soon as they are formed, by condensation at low temperature, has produced evidence of four distinct particles: A, formed in all the conditions of excitation for the three vapours, identifiable probably as the benzyl radical; B, formed by greater excitation of toluene and ethylbenzene; C_1, only given by toluene; C_2, only given by ethylbenzene.

539.2 : 535.37

6200 PHOSPHORESCENCE OF NITROGEN AND NITROGEN–ARGON DEPOSITED FILMS AT 4.2°K.
H.P.Broida and R.W.Nicholls.
J. chem. Phys., Vol. 32, No. 2, 623-4 (Feb., 1960).

Phosphorescence was induced in nitrogen and nitrogen–argon mixtures (deposited at 4.2°K after passage through a microwave discharge) by illumination of the deposits with a variety of filtered light sources over the wavelength range 2000-10 000 A. The spectrum of the phosphorescence contains only the α and α' features of N I at 5230 A and is interpreted in terms of a restimulation of the green afterglow (Abstr. 5502 of 1959). R.W.Nicholls

539.2 : 535.37

6201 SPECTRA EMITTED FROM RARE GAS–OXYGEN SOLIDS DURING ELECTRON BOMBARDMENT.
L.J.Schoen and H.P.Broida.
J. chem. Phys., Vol. 32, No. 4, 1187-96 (April, 1960).

Light emission from rare gas solids containing small amounts of oxygen was excited by an electron bombardment technique. The Herzberg bands of oxygen and a line group believed to be the $^1S \rightarrow {}^1D$ transition of the neutral oxygen atom form the strongest features of the observed spectra. In a neon matrix, the Second Negative system of O_2^+ was identified. The effect of the various solids on the vibrational structure of the Herzberg bands is discussed.

539.2 : 535.37

6202 ON THE EDGE LUMINESCENCE OF ZINC OXIDE.
B.Andress and E.Mollwo.
Naturwissenschaften, Vol. 46, No. 22, 623-4 (1959). In German.

Curves are given for the emission of single crystal ZnO under 9 kV electrons, the light being measured separately according to its polarization being parallel or perpendicular to the crystal c-axis. The parallel component is weaker than the other, and the more so as the temperature falls. The ratio of parallel to perpendicular intensity agrees with the formula $\exp(-\epsilon/kT)$, where the excitation energy $\epsilon = 0.031$ eV. This is also the value of the difference in band peak position at 90, 273 and 468°K, the parallel component being always located at the shorter wavelength. S.T.Henderson

539.2 : 535.37 : 539.1.07

6203 DIFFERENCES IN FLUORESCENCE DECAY IN ZnS : Ag FOR PARTICLES OF DIFFERENT IONIZATION DENSITY. J.Warncke and H.Neuert.
Naturwissenschaften, Vol. 47, No. 1, 11 (1960). In German.

Scintillation decay can be resolved into three processes occurring in different proportions, with time constants ~0.075, ~0.65, and 3-6 μsec respectively. Only the last is found with γ-rays, but 4 MeV α-particles and 2.5 MeV protons produce all three. The distribution of pulse rise times allows the α-particle and proton scintillations to be clearly distinguished. S.T.Henderson

539.2 : 535.37 : 539.1.07

6204 THE RESPONSE OF PLASTIC SCINTILLATORS TO PROTONS. H.C.Evans and E.H.Bellamy.
Proc. Phys. Soc., Vol. 74, Pt 4, 483-5 (Oct. 1, 1959).

The theoretical relation between specific fluorescence and specific energy loss developed by Birks (Abstr. 913 of 1952) is tested for 14.8 MeV protons exciting a plastic scintillator and found to apply quite accurately. G.F.J.Garlick

539.2 : 535.37

6205 THE CATHODOLUMINESCENCE EFFICIENCY OF THIN MICROCRYSTALLINE LAYERS. II. THE INTRINSIC EFFICIENCY. G.Gergely.
Z. Phys. Chem. (Leipzig), Vol. 211, No. 5-6, 274-81 (1959).

For previous part, see Abstr. 2963 (1960). To explain dependence of emission on primary electron energy the intrinsic efficiency of excitation is assumed to be constant but it is also assumed that a "dead" layer exists on the phosphor surface of thickness ~ 100-250 A depending on the specific material. Correlation is found between the energy loss of primary electrons and the energy required to produce each luminescence photon. See also Abstr. 9689 (1959). G.F.J.Garlick

539.2 : 535.37

6206 ON THE ELECTROLUMINESCENCE OF POWDERED ZINC SULPHIDE LAYERS. V.V.Antonov-Romanovskij.
Czech. J. Phys., Vol. 9, No. 2, 146-60 (1959).

The voltage dependence of electroluminescence in very thin binderless layers confirms the impact ionization theory of the mechanism. Comparison of photoluminescence and electroluminescence of ZnS:Cu containing Nd or Eu allows an estimation of the volume of the crystal in which the light output occurs. Transfer of excitation from the region of field concentration to the whole volume is shown by experiments on the relation between electroluminescence in ZnS:Cu,Al and the stored light sum. The same conclusions arise from studies of relaxation processes which control the proportions of constant and variable electroluminescence. S.T.Henderson

539.2 : 535.37

6207 COURSE OF ELECTROLUMINESCENCE OF ZnS:Cu,Mn. S.Damašková.
Czech. J. Phys., Vol. 9, No. 4, 529 (1959).

Alternating square-wave pulses were applied to ZnS:Cu,Mn,Al. The brightness wave-forms are interpreted as the result of two processes, the direct excitation of Mn centres, and the impact ionization of Cu and Mn centres with transfer of the excitation energy from Cu to Mn. S.T.Henderson

539.2 : 535.37

6208 THERMOLUMINESCENCE AND PHOSPHORESCENCE SPECTRA OF SOME PURE AND IMPURITY ACTIVATED ALKALI HALIDES. B.C.Dutta and A.K.Ghosh.
Indian J. Phys., Vol. 32, No. 12, 578-9 (Dec., 1958).

NaCl, NaF, NaI, KI, LiCl and thallium activated NaCl, NaBr, KI, were studied in the spectral range 330 mμ–650 mμ.

539.2 : 535.37

6209 THE GUDDEN–POHL EFFECT OF ZnS:Cu.
Y.Kotera and K.Naraoka.
J. Electrochem. Soc., Vol. 106, No. 12, 1066 (Dec., 1959).

Measurement of the Gudden–Pohl effect and thermoluminescence of ZnS:Cu showed that in the cubic phase, the effect decreased with increasing temperature between 20° and 120°C, and no glow peak occurred in this range, while in hexagonal ZnS the effect had a maximum at 70°C, and a glow peak occurred at 55°C. J.Franks

539.2 : 535.37

6210 THE THERMOLUMINESCENCE OF PRECIPITATED CALCIUM FLUORIDE. C.Bettinali.
R.C. Accad. Naz. Lincei, Vol. 26, No. 6, 777-81 (June, 1959). In Italian.

The material prepared at room temperature shows thermoluminescence with a maximum at ~ 300°C, whereas mineral fluorites do so below 200°. Exposure to 35 kV X-rays has little effect on the precipitated samples unless they have been previously heated to 400°, when the thermoluminescence may be increased by a factor up to 10^3. S.T.Henderson

MAGNETIC PROPERTIES OF SOLIDS

539.2 : 538.2

6211 MAGNETIC SUSCEPTIBILITY OF Fe- and Zn-DOPED Ge. D.Geist.
Z. Phys., Vol. 156, No. 2, 123-32 (1960). In German.

Germanium single crystals grown from an iron-doped melt possess a diamagnetic susceptibility, shifted in the paramagnetic direction, which is independent of the field. This shift is caused by ferromagnetic precipitates. The distribution coefficient was as high as 10^{-4}. Analogous experiments with nickel give no change in

the susceptibility. Zinc has acceptor states with two ionization levels and should cause a dependence of susceptibility on temperature. However, its solubility is so small that only the contribution from free holes is measurable.

539.2 : 538.2

6212 ON THE THEORY OF THE DIAMAGNETISM OF THE ELECTRON GAS IN CRYSTALS. M.V.Nitsovich.
Fiz. Metallov i Metallovedenie, Vol. 7, No. 5, 641-9 (1959).
In Russian.

The partition function for an electron gas in a magnetic field H is computed up to the terms in H^3. The magnetic susceptibility tensor for an anisotropic crystal is calculated and is given in full. Besides the usual terms, three new types of term are noted, all giving but small contributions. A.F.Brown

539.2 : 538.2

6213 MAGNETIC INVESTIGATIONS OF SPIN-FREE COBALTOUS COMPLEXES. II. TETRAHEDRAL COMPLEXES. R.H.Holm and F.Cotton.
J. chem. Phys., Vol. 32, No. 4, 1168-72 (April, 1960).

For Pt I see Abstr. 12446 (1959). The magnetic moments of 17 tetrahedral complexes of Co(II) were carefully measured, most of them over a temperature range. The Curie–Weiss law is found to hold in all cases where the temperature dependence was studied. The variations of the orbital contribution to the moment are shown to be in accord with expectation from ligand field theory (Schlapp and Penney), and the utility of the results in correlating magnetic properties, spectra, and structures of Co(II) complexes is briefly discussed.

539.2 : 538.2

6214 ON THE MAGNETIC SUSCEPTIBILITY AND ANISOTROPY OF TRIVALENT VANADIUM ALUM UNDER THE CRYSTALLINE ELECTRIC FIELD HAVING PREDOMINANTLY CUBIC SYMMETRY WITH A SMALL TRIGONAL SYMMETRY. A.S.Chakravarty.
Proc. Phys. Soc., Vol. 74, Pt 6, 711-20 (Dec., 1959).

On the assumption that the cubic field for V^{3+} is not strong enough to break down the Russell–Saunders (l–l) coupling, the magnetic susceptibility of V^{3+} has been calculated in a generalized way using Abragam and Pryce's Hamiltonian and wave-functions. The susceptibility expression contains four parameters α, α' (the effective crystalline Lande factors), Δ (the trigonal field orbital parameter) and λ (the crystalline spin–orbit coupling constant). An excellent agreement with the experimental results of Van den Handel and Siegert and Dutta Roy (1958) are obtained by taking $\alpha = 1.10$, $\alpha' = 1.35$, $\Delta = -1390\ cm^{-1}$, $D = 4.8\ cm^{-1}$ and $\lambda = 64\ cm^{-1}$. The reduction of λ from its free ion value $104\ cm^{-1}$ is due to the inclusion of the covalency factor ($f^2 = 0.62$, arising from overlap of the 3d-orbital wave-functions of V^{3+} with the σ- and π-wave-functions of the surrounding oxygen). The values of α, α' and Δ are consistent with reasonable values of the cubic and trigonal field parameters.

539.2 : 538.2 : 537.311

6215 MAGNETISM OF INTERACTING DONORS. E.Sonder and H.C.Schweinler.
Phys. Rev., Vol. 117, No. 5, 1216-21 (March 1, 1960)

For previous work, see Abstr. 5119 (1958). The magnetic susceptibility of donor centres in semiconductors is calculated for the case of small interactions between closely adjacent donors. A hydrogenic model is assumed for the donor centres. The random distribution of the centres, as well as the variation of the energy of interaction with separation distance of pairs of donors, is taken into consideration. A twofold modification to the Curie law (which is correct for independent donors) is predicted by the resulting expression, namely, a curvature as well as a decrease of the slope of the Curie plot of the susceptibility versus inverse temperature. Both of these effects increase with the donor density, becoming appreciable in silicon with 10^{17}–10^{18} donors/cm and in germanium in the range around 10^{16} donors/cm. The theory is in good agreement with results of measurements.

539.2 : 538.2

6216 THE RATIO OF THE ISOLATED AND THE ADIABATIC SUSCEPTIBILITY OF PARAMAGNETIC CRYSTALS. W.J.Caspers.
Physica, Vol. 25, No. 1, 43-9 (Jan., 1959).

For certain powdered crystals the value 4/5 is derived for the ratio of the isolated susceptibility (χ_{iS}) and the adiabatic susceptibility (χ_S) in the case of a high-frequency field parallel to a strong constant field H. The derivation is given by means of geometrical arguments which give an insight into the remarkable fact that for so many crystals one finds the same value for the ratio of the two susceptibilities.

539.2 : 538.2

6217 STATISTICAL MECHANICS OF A DISORDERED ISING LATTICE. J.Seiden.
C.R. Acad. Sci. (Paris), Vol. 250, No. 2, 308-10 (Jan. 11, 1960).
In French.

The method of Abstr. 3625 (1959) is used to calculate the magnetic susceptibility of unionized impurities in a semiconductor and the Curie point T_C of ferromagnetic solid solutions of rare earths in a superconductor. $T_C \propto n$, the concentration of rare earth ions, in agreement with the experiments of Matthias, Suhl and Corenzwit (Abstr. 7980 of 1958). D.M.Edwards

539.2 : 538.1

6218 MODIFIED BOHM AND PINES COLLECTIVE DESCRIPTION OF ELECTRON INTERACTIONS IN CRYSTALS. SPIN WAVE THEORY OF FERROMAGNETISM. III. J.Śledzik.
Acta phys. Polon., Vol. 18, No. 4, 295-306 (1959).

For Pt II, see Abstr. 8834 (1959). The Bloch spin-wave theory of ferromagnetism is presented. Starting from the Hamiltonian in the Bohm–Pines representation, the Slater–Bloch equations and formulae are obtained for mean magnetization for three types of cubic lattice. All the calculations are made on the assumption that the atoms are monovalent. The value of the parameter λ_C is estimated for crystalline hydrogen.

539.2 : 538.2

6219 FERROMAGNETIC EXCHANGE BETWEEN COUPLED PAIRS OF ELECTRONS. F.D.Stacey.
Austral. J. Phys., Vol. 11, No. 3, 447-8 (Sept., 1958).

Suggests that a positive exchange interaction may be obtained between pairs of parallel coupled spins. D.M.Edwards

539.2 : 538.2

6220 MAGNETIC PROPERTIES OF THE COMPOUND Mn_3Ge_2. N.G.Fakidov and Yu.N.Tsiovkin.
Fiz. Metallov i Metallovedenie, Vol. 7, No. 5, 685-8 (1959).
In Russian.

In Mn–Ge alloys containing 40-95 atomic % Ge there is only one ferromagnetic phase, Mn_3Ge_2. The ferromagnetic and paramagnetic Curie points are respectively 283° and 300°K. At 113°K Mn_3Ge_2 has a first order phase transition, and the electrical conductivity ~ 10^{-3} ohm cm, which together with the observed magnetic moment of the Mn atom in Mn_3Ge_2 of 2.5 μB, suggests that the binding is of metallic type. A.F.Brown

539.2 : 538.2

6221 VARIATION WITH TEMPERATURE OF THE MAGNETIC SUSCEPTIBILITY OF SOME TRANSITION ELEMENTS. H.Kojima, R.S.Tebble and D.E.G.Williams.
Nature (London), Vol. 185, 90-1 (Jan. 9, 1960).

Reports results for Ti, Zr, Nb, Ta, Rh, Pt between 20° and 1750° C. E.P.Wohlfarth

539.2 : 538.2

6222 MAGNETIC PROPERTIES OF A SINGLE CRYSTAL OF MAGNETOPLUMBITE. G.Villers.
C.R. Acad. Sci. (Paris), Vol. 249, No. 15, 1337 (Oct. 12, 1959).
In French.

The anisotropy constants for magnetoplumbite ($6Fe_2O_3.PbO$) have been determined in the temperature range from 77° to 293°K. The value of K_1 at room temperature is 2.5×10^6; K_2 is not greater than one per cent of this and higher terms are negligible. The results reported do not agree with those obtained by Pauthenet and Rimet (Abstr. 675 of 1960). S.A.Ahern

539.2 : 538.2

6223 FERROMAGNETIC ANISOTROPY IN CUBIC CRYSTALS. F.Keffer and T.Oguchi.
Phys. Rev., Vol. 117, No. 3, 718-25 (Feb. 1, 1960).

A re-evaluation has been made of Van Vleck's second-order perturbation theory of dipolar-type anisotropy in cubic ferromagnets. In the low-temperature limit of strong correlation between the direction of neighbour spins, the first anisotropy constant K_1 varies as the 10th power of the magnetization. The theory is somewhat analogous to a previous treatment of quadrupolar-type anisotropy in the strong-correlation limit. In both cases, the results are

in agreement with the Akulov–Zener classical theory. For the dipolar case, complete agreement is also established between the Dyson-type spin-wave analysis of Charap and Weiss and the Holstein–Primakoff approach. Higher order terms in the latter are shown to lead to the Charap–Weiss correction from exchange interaction between spin waves, and this correction is extended to $S > \frac{1}{2}$. Essentially the same correction is obtained very easily from a simple modification of the Van Vleck formalism to take careful account of the average energy involved in simultaneous reversal of neighbour spins. It is shown that spin-wave theory, in agreement with classical theory, predicts identical values of dipolar-type anisotropy whether measured statically in a torque experiment or dynamically in a microwave resonance experiment.

539.2 : 538.2

6224 THE INFLUENCE OF PLASTIC DEFORMATION BY COLD ROLLING ON COERCIVITY.

F.Kroupa and Z.Málek.
Czech. J. Phys., Vol. 9, No. 5, 627-37 (1959). In German.

The dependence of the coercivity on plastic deformation for iron, nickel and some iron-nickel alloys has been measured parallel and perpendicular to the rolling direction. The results are discussed with reference to alloy composition and the uniaxial induced anisotropy.

A.J.Manuel

339.2 : 538.2

6225 QUANTUM THEORY OF THE FERROMAGNETIC ANISOTROPY OF UNIAXIAL CRYSTALS.

S.V.Tyablikov and T.Shiklosh [Siklós].
Acta phys. Hungar, Vol. 10, No. 3, 259-69 (1959). In Russian.

The magnetic anisotropy of ferromagnetic crystals is treated as anisotropic interactions between the electrons of the unfilled subshells. The energy spectrum of magnetically uniaxial ferromagnetic monocrystals is determined. The magnetization, as a function of temperature and of outer magnetic field, is calculated in directions parallel and normal to the principal crystal axis.

539.2 : 538.2

6226 QUANTUM MECHANICAL THEORY OF FERROMAGNETIC SEMICONDUCTORS. T.Shiklosh [Siklós].
Acta phys. Hungar., Vol. 7, No. 1, 141-9 (1957). In Russian.

Deals with the temperature dependence of the spontaneous magnetization in the low temperature range. The calculations are based on Néels assumption that, from the standpoint of magnetism, the lattice of ferrites can be regarded as the sum of sub-lattices. This assumption has been confirmed by neutron scattering investigations. The calculations are carried out using a version of the method of second quantization, due to Bogolyubov and Tyablikov (Abstr. 5597 of 1949). The ground state and the spectrum of the electron system in ferrites are determined. It is shown that in the low-temperature range, the temperature dependence of spontaneous magnetization of ferrites obeys a law similar in type to that valid for ferromagnetic metals and binary alloys: $M_s(T) = M_s[1-\alpha T^{3/2}]$.

539.2 : 538.2

6227 HIGH RESISTIVITY NICKEL–IRON ALLOYS WITH RECTANGULAR HYSTERESIS LOOPS. A.Hart.
Brit. J. appl. Phys., Vol. 11, No. 2, 58-60 (Feb., 1960).

Because of its rectangular hysteresis loop, magnetically annealed 65/35 nickel–iron alloy is suitable for many applications. The alloy has a low resistivity, however, and eddy-current effects limit the performance of many devices made from the alloy. An alloy with similar magnetic characteristics and a higher resistivity is very desirable. A method of magnetic annealing is described which allows magnetic properties, practically identical to those of 65/35 alloy, to be induced in alloys containing up to 3% molybdenum, and nickel and iron in the ratio 65/35. The resistivity of the 3% molybdenum alloy is 53 μohm cm, compared with 19 μohm cm, for the binary 65/35 alloy. The new annealing method takes rather longer than that previously used, but is more difficult to carry out; it can be used on alloys which cannot be successfully treated by a "normal" magnetic anneal. Compared with available 50/50 grain-oriented alloy, the 3% molybdenum alloy has a lower coercivity and a higher resistivity, but its saturation flux density is some 20% less.

539.2 : 538.2

6228 A NOTE CONCERNING THE FORMALISM OF HOLSTEIN AND PRIMAKOFF. Yu.A.Izyumov.
Fiz. Metallov i Metallovedenie, Vol. 7, No. 5, 669-72 (1959).
In Russian.

See Abstr. 288 (1941). The uses of spin operators and Bose operators in the theory of magnetic ordering are examined on general matrix theory.

A.F.Brown

539.2 : 538.2

6229 THE THERMOMAGNETIC BEHAVIOUR OF PURE NICKEL FERRITE. L.F.Bates and H.Clow.
Proc. Phys. Soc., Vol. 75, Pt 1, 17-23 (Jan., 1960).

The small heat changes accompanying the magnetization of pure nickel ferrite have been measured for a rod specimen at -10° and 18°C. By making use of the correctness of current theory for thermal changes accompanying the magnetization of ferromagnetic substances in high fields, the results have been analysed, and some slight support found for the Lilley disperse field theory.

539.2 : 538.2

6230 THE DISTRIBUTION FUNCTION FOR THE ACTIVATION FIELDS OF FERROMAGNETIC DOMAINS.

B.Rothenstein.
Czech. J. Phys., Vol. 9, No. 2, 215-20 (1959). In German.

The activation fields for reversible wall motions are taken to follow a Gaussian distribution, leading to an explanation of the internal friction peak; the results are compared with experiments on nickel and iron wires.

E.P.Wohlfarth

539.2 : 538.2

6231 BLOCH WALL SEPARATIONS IN THIN Si-Fe SPECIMENS WITH CUBE TEXTURE. R.Brenner.
Z. angew. Phys., Vol. 12, No. 3, 107-11 (March, 1960). In German.

The separation λ was calculated as a function of grain size D, tape thickness d and texture angle α, and found to be almost independent of d but to vary as $D^{1/2}\alpha^{-2}$.

E.P.Wohlfarth

539.2 : 538.2

6232 MAGNETIC STRUCTURE IN SMALL MONOCRYSTALLINE PARTICLES OF THE MnBi ALLOY.

Ya.S.Shur, E.V.Shtol'ts and V.I.Margolina.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 46-50 (Jan., 1960).
In Russian.

The magnetic structure of various-sized particles (from 100 μ down to a few microns) of a manganese–bismuth alloy was studied by the powder-pattern method. It was found that with the particle size decreasing the type of magnetic structure changes in a regular fashion. In particles several microns and less in size one-domain magnetic structure was detected.

539.2 : 538.2

6233 DEPENDENCE OF THE MAGNETIC STRUCTURE OF A COBALT CRYSTAL ON ITS SIZE.

G.S.Kandaurova, Ya.S.Shur and F.V.Maslennikova.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 60-3 (Jan., 1960).
In Russian.

The paper gives results of powder-pattern observations of the changes in magnetic structure of a cobalt monocrystal in its basal plane as the crystal thickness was decreased from 515 to 15 μ. It was established that at small thicknesses (below 200 μ) the domain width changes proportionally to the square root of the crystal thickness; at greater thicknesses deviations from this relationship are observed.

539.2 : 538.2

6234 THE UNIAXIAL MAGNETIC ANISOTROPY OF THIN FILMS AND ITS TIME DEPENDENCE.

Z.Málek, W.Schüppel, O.Stemme and W.Andrä.
Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 3-4, 211-16 (1960).
In German.

Reports results of direct measurements of the uniaxial anisotropy constant K of evaporated and electrodeposited nickel and permalloy films. The anisotropic films show, under some conditions, a room temperature variation of K with time if a magnetic field is applied parallel or perpendicular to the easy axis; in the last case it may even be possible for the easy axis to be rotated through 90°.

E.P.Wohlfarth

539.2 : 538.2

6235 STUDY OF THE MAGNETIZATION OF THIN NICKEL FILMS. T.Rappeneau.
C.R. Acad. Sci. (Paris), Vol. 250, No. 4, 674-6 (Jan. 25, 1960).
In French.

Hysteresis curves have been obtained for fields up to 100 Oe using a magnetometer method and the results compared with previous measurements of magnetoresistance on the same specimens.

A.J.Manuel

539.2 : 538.2

6236 DETERMINATION OF MAGNETIZATION DISTRIBUTION IN THIN FILMS USING ELECTRON MICROSCOPY.

H.W.Fuller and M.E.Hale.

J. appl. Phys., Vol. 31, No. 2, 238-48 (Feb., 1960).

Some new developments are reported in the technique of observing magnetization in thin ferromagnetic films by transmission electron microscopy, and the results of some observations are described that contribute to an understanding of the magnetic character of thin films. Two modes of operation of a microscope are explained, one using projector magnification alone, and one using both objective and projector lenses. The intensity distribution images of the magnetization distribution in a thin film is derived from the Lorentz force acting on an electron passing through the film. The intensity distributions for some simple domain walls are computed and compared in various ways with experimental observations. A magnetization ripple model is proposed and justified to explain an intensity texture observed principally when projector magnification alone is used. The texture is shown to be an orthogonal map of the magnetization of the film, and to be of use in interpreting wall structures. High magnification and resolution wall micrographs are obtained using objective magnification, and a direct measurement of the wall thickness and shape can be made in this way. 180° walls in a Fe–Ni alloy film of about 200 A thickness are found to have a width of $2\delta = 1500$ A, using the wall model $\cot^{-1}\theta = -\sinh x/\delta$. The effect of finite resolution on the measurements is discussed It is shown that the magnetization distribution of a wall can be obtained from the measured intensity distribution by inverting the parametric equation solution for the intensity distribution.

539.2 : 538.2

6237 OBSERVATIONS ON MnBi FILMS DURING HEAT TREATMENT. L.Mayer.

J. appl. Phys., Vol. 31, No. 2, 346-51 (Feb., 1960).

Observations of magnetic surface phenomena, which were made during the vacuum heat treatment necessary to develop ferromagnetic MnBi films from their nonmagnetic constituents are described. A vacuum hot stage for a metallurgical microscope was constructed in order to accomplish by means of the Kerr magneto-optic effect this visual observation of incipient ferromagnetism. MnBi films with some areas already magnetic were first observed. The phenomena occurring during evolution of the magnetic state in the areas adjacent to the already magnetic areas could be observed readily and the experiments could be reproduced consistently. Attempts to nucleate this transformation in the vacuum hot stage were only partly successful because reproducibility could not be achieved. Growth of a new magnetic area on MnBi film manifests itself first as an essentially structureless area. This structureless area then becomes an area of antiparallel domains. The size of the domains depends mainly on the duration of the existence of the structureless state. Large domains tend to develop if the structureless state is kept in existence for a short time and vice versa. In addition to the immediate practical goal of improving reproducibility in the preparation of MnBi films such visual observation of the nascent state of ferromagnetism may also be of general interest to the physics of magnetism.

539.2 : 538.2

6238 THE VARIATION OF THE REMANENCE OF POLYCRYSTALLINE NICKEL WIRES WITH APPLIED TENSILE STRESS. C.Schwink and G.Zankl.

Z. Phys., Vol. 158, No. 2, 181-95 (1960). In German.

The reduced remanence j_r was measured as a function of a previously applied tensile stress P for wire specimens with different textures and grain sizes. A rapid decrease of j_r with increasing P beyond about 1-2 kg mm^{-2}, where plastic deformation sets in, was followed by a partial recovery towards a limiting value 0.5, as magnetocrystalline effects are replaced by stress anisotropy effects.

E.P.Wohlfarth

539.2 : 538.2

6239 kπ WALLS IN FERRITES. M.Paulis.

C.R. Acad. Sci. (Paris), Vol. 250, No. 7, 1213-15 (Feb. 15, 1960). In French.

When two 180° domain walls approach each other under the influence of a magnetic field, the walls disappear if the rotation of the magnetization is in opposite senses. If the rotation is in the same sense in both walls, they are not destroyed, even by large fields, and form a 2π wall. Multiple walls (kπ) can be built up with alternating fields. Photomicrographs show the merging of mobile walls into immobile multiple walls and the splitting of a multiple wall into several multiple walls. Some other peculiarities of walls in ferrites are also mentioned.

R.C.Kell

539.2 : 538.2

6240 THE TEMPERATURE DEPENDENCE OF THE RECTANGULARITY COEFFICIENTS OF MANGANESE–MAGNESIUM FERRITES. J.Brož and J.Šternberk.

Czech. J. Phys., Vol. 9, No. 4, 531-2 (1959). In German.

Reports results of the temperature variation (over the range from −200° to +100° C) of the reduced remanent induction and of the ratio $B(-\frac{1}{2}H_{max})/B(+H_{max})$. Whereas the first ratio varies monotonically with temperature, the second exhibits maxima and minima which remain unexplained.

E.P.Wohlfarth

539.2 : 538.2

6241 RELATION BETWEEN HYSTERESIS LOOP RECTANGULARITY AND THE INTERNAL DEMAGNETIZATION COEFFICIENT OF MANGANESE–MAGNESIUM FERRITES. J.Brož and J.Šternberk.

Czech. J. Phys., Vol. 9, No. 5, 666-7 (1959). In German.

The reduced remanent induction bears an inverse relation to the internal demagnetization coefficient and extrapolates to 1 as $N_i \to 0$.

E.P.Wohlfarth

539.2 : 538.2

6242 ON THE QUESTION OF THE ARBITRARY CYCLIC MAGNETIZATION OF Mn–Mg AND Ni–Zn FERRITES. V.V.Kobelev and I.I.Nadashkevich.

Fiz. tverdogo Tela, Vol. 1, No. 7, 1140-6 (July, 1959). In Russian.

The effect of the magnetic history of certain Mn–Mg and Ni–Zn ferrites, in the form of toroidal rings, on their subsequent magnetic properties is studied. By means of a suitable valve circuit, of which a diagram is given, alternating and uni-directional magnetizing field impulses are given to specimens, initially at some point on a hysteresis cycle. It is shown that the magnetic behaviour is not determined completely by the initial state, but also by the initial direction, number and intensity of the applied impulses. Assuming that the thick-walled specimens are magnetized in concentric ring layers, then for a given magnetizing current, the field and induction in the outer layers are less than in the inner ones. When small alternating impulses are applied, only the innermost ring layers undergo cyclic changes of magnetization. This theory is used to explain the above experimental results. [See Abstr. 197B (1954), Proc. Inst. Radio Engrs, Vol. 41, 1407-21 (Oct., 1953); and 2587B (1956), Proc. Inst. Radio Engrs, Vol. 44, No. 3, 321-32 (March, 1956)].

N.Davy

539.2 : 538.2

6243 ULTRA HIGH FREQUENCY PROPERTIES OF YTTRIUM AND LUTETIUM FERRITES WITH GARNET-TYPE STRUCTURE. A.G.Gurevich, I.E.Gubler and A.P.Safant'evskii.

Fiz. tverdogo Tela, Vol. 1, No. 12, 1862-5 (Dec., 1959). In Russian.

Yttrium and lutetium ferrites, $Y_3Fe_5O_{12}$ and $Lu_3Fe_5O_{12}$, should display similar ferromagnetic absorption properties, since the Y^{3+} and Lu^{3+} ions are non-magnetic. Experimental values of $2\Delta H$ for specimens of these two ferrites, prepared in different ways, are plotted against η, the relative density. The points for both lie close together, for the same value of η, implying that they have nearly equal anisotropy constants and saturation intensities. The straight line graph of an equation suggested by the authors fits the points more closely than does the curve representing Schlömann's equation. Other graphs represent the measured components of the complex permeability of thin disks of polycrystalline $Y_3Fe_5O_{12}$ at wavelengths of 3.2, 10 and 50 cm, plotted against the constant magnetic field. The components of the complex dielectric constant of yttrium ferrite have also been measured. It is suggested that lutetium ferrite will give nearly the same values. (See Abstr. 241, 398, 3663 and 13449 of 1959).

N.Davy

539.2 : 538.2

6244 ON THE MEASUREMENT OF THE GALVANOMAGNETIC PROPERTIES OF FERRITES. K.Zaveta.

Fiz. tverdogo Tela, Vol. 2, No. 1, 106-8 (Jan., 1960). In Russian.

Belov and his co-workers found experimentally that the relative change of resistance $\Delta R/R$ of manganese ferrites on applying a magnetic field H, when plotted against temperature, displayed an anomalous maximum value near the Curie point. On the other hand, Parker, in the case of Ni–Zn ferrites, found a gradual fall of $\Delta R/R$ to zero with rise of temperature through the Curie point. The present paper attempts to explain this discrepancy by a short classical thermodynamical discussion. On account of the low thermal conductivity of ferrites, the conditions of measurement of $\Delta R/R$ are usually adiabatic. It is found that $(\Delta R/R)_S = aH^{3/2} + bH$, where a

and b are constants. The first term on the right represents the true isothermal relative change of resistance. The second is an adiabatic term due to the magnetocaloric effect, and in the case of the badly conducting polycrystalline manganese ferrites is the dominating term. The anomaly in the $\Delta R/R$ versus T graph is ascribed to the same cause. It has been proved experimentally that $\Delta R/R = aH^{2/3}$ near the Curie point in the case of metallic ferromagnetics, which have a high thermal conductivity (See Abstr. 7104 of 1957 and 5743 of 1959.) N.Davy

539.2 : 538.2

6245 THE FERRIMAGNETISM OF NON-STOICHIOMETRIC IRON SULPHIDES. R.Perthel.

Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 5-6, 273-95 (1960). In German.

Reports results of measurements of the magnetization of FeS_{1+n} ($0 \leq n \leq 0.15$); the temperature dependence of the magnetization over the range $0.10 \leq n \leq 0.15$ was reported, a maximum being reached at $n = 0.13$. The results are interpreted in terms of an order–disorder process. Investigations were also made on mixed sulphides $Co_xFe_{1-x}S_{1.15}$, which are ferrimagnetic up to $x = 0.5$, and on the effects of oxidation of the sulphides. E.P.Wohlfarth

539.2 : 538.2

6246 MAGNETIZATION REVERSAL AND ASYMMETRY IN COBALT VANADATE (IV).

N.Menyuk, K.Dwight and D.G.Wickham.

Phys. Rev. Letters, Vol. 4, No. 3, 119-20 (Feb. 1, 1960).

The material has a ferrimagnetic Curie temperature of 158°K and a compensation temperature of 70°K. When cooled in an applied field the net magnetization below the transition point is opposite to H. A hysteresis curve which shows large asymmetry about the magnetization axis is obtained at 4.2°K for fields applied parallel to the direction of the field applied during cooling. An explanation of these effects is offered in terms of the different strengths of the $Co^{2+}-O^{2-}-Co^{2+}$ and the $Co^{2+}-O^{2-}-V^{4+}$ and V^{4+} V^{4+} interactions. D.J.Oliver

539.2 : 538.2

6247 NEW SOLUTIONS OF THE MOLECULAR FIELD EQUATIONS FOR ANTIFERROMAGNETISM IN AN ORTHORHOMBIC CRYSTAL AT ZERO TEMPERATURE.

O.P.Van Wier, T.Van Peski-Tinbergen and C.J Gorter.

Physica, Vol. 25, No. 2, 116-32 (Feb., 1959).

The solutions of the molecular field equations for antiferromagnetism in an orthorhombic crystal are analysed at zero temperature for an external field applied parallel to the axis preferred for antiferromagnetic alignment or to the second next preferred axis. Besides the a-, b- and p-solutions analysed earlier (Abstr. 7390 of 1952; 1043 of 1954; 5209 of 1956), two pairs of solutions — called the a*- and the b*-solutions — are found to be possible which are unsymmetrical with respect to the field direction. The conditions under which these new solutions mathematically exist and are dynamically and thermodynamically stable are studied. Transitions from an a- to an a*-solution and from an a*-solution to a b- or b*-solution, as well as from a b- or b*-solution to a p-solution are of the second order. The analysis completes an earlier investigation by Néel (Abstr. 5213 of 1956)

539.2 : 538.2 : 548.7

6248 ANTIFERROMAGNETIC STRUCTURE OF CrN.

L.M.Corliss, N.Elliott and J.M.Hastings.

Phys. Rev., Vol. 117, No. 4, 929-35 (Feb. 15, 1960).

Chromium nitride, crystallizing with the rock salt structure, has been found to be antiferromagnetic with a Néel point of 0°C. The magnetic ordering scheme, as determined by neutron diffraction, is that of the fourth kind, with moments arranged in double ferromagnetic sheets which alternate along a line parallel to a face-diagonal. The structure is orthorhombic below the transition and the space group Pnma has been tentatively assigned. The atomic displacements accompanying the distortion have been partially determined from the diffraction data and are discussed in relation to the magnetic structure. A value of 2.4 μ_B has been assigned to the Cr moment; the moment direction is parallel to the b axis of the orthorhombic cell (face-diagonal of the cube).

Magnetic Resonances

539.2 : 533.27

6249 WHAT IS FERROMAGNETIC RESONANCE? R.A.Waldron.

Brit. J. appl. Phys., Vol. 11, No. 2, 69-73 (Feb., 1960).

It is shown that two distinct resonance effects take place in ferrite samples at microwave frequencies, ferromagnetic resonance and an effect due to the shape of the specimen. The latter effect is called Kittel resonance in this paper. It is commonly supposed that the two effects are the same, but it is shown that this is not the case. In ferromagnetic resonance, the diagonal and off-diagonal elements of the permeability tensor (μ and α respectively) exhibit anomalous dispersion, and microwave fields are excluded from the specimen. In Kittel resonance, nothing spectacular is happening to μ and α, but the fields in the specimen become very large, giving rise to a large loss; it is this effect that is observed in resonant cavity experiments. The behaviour of cavities and waveguides containing ferrites is discussed in the light of these facts, and a new interpretation is arrived at of certain effects in waveguides when $|\mu| < |\alpha|$.

539.2 : 538.27

6250 ON THE ORIGIN OF THE WIDTH OF THE FERROMAGNETIC RESONANCE CURVE. Z.Frait.

Czech. J. Phys., Vol. 9, No. 6, 750-1 (1959).

539.2 : 538.27

6251 FERROMAGNETIC RESONANCE IN SINGLE CRYSTALS OF YTTRIUM FERRITE. A.G.Gurevich and I.E.Gubler.

Fiz. tverdogo Tela, Vol. 1, No. 12, 1847-50 (Dec., 1959). In Russian.

The ferromagnetic resonance method is applied to single crystal crystals of $Y_3Fe_5O_{12}$, in the form of spheres of diameter 0.3 to 0.8 mm, at a wavelength of 3.25 cm. The results of absorption measurements are represented by graphs and two tables. One set of graphs shows the relation between $2\Delta H$ and the diameter of the spheres, for three grain sizes of the final polishing powder. Another shows the relation between (a) $2\Delta H$ and (b) the resonance field, and the orientation of the specimen, relative to the constant magnetic field. $2\Delta H$ proves to be most nearly constant when the crystals are purest and are grown very slowly from the melt. The g-factor obtained (2.00) is similar to that for $MnFe_2O_4$, but the first anisotropy constant K_1 (the mean of three values is $\sim -5.1 \times \times 10^3$ ergs/cm^3, while that of $MnFe_2O_4$ is -2.8×10^4 ergs/cm^3. Also the spread of the three values of K_1 exceeds the limits of experimental error. (See Abstr. 241, 398, 3663, 8990 and 13449 of 1959). N.Davy

539.2 : 538.27

6252 THEORY OF FERROMAGNETIC RESONANCE IN RARE EARTH GARNETS. III. GIANT ANISOTROPY ANOMALIES. C.Kittel.

Phys. Rev., Vol. 117, No. 3, 681-7 (Feb. 1, 1960).

For Pt II. see Abstr. 1821 of 1960. The giant sharp anisotropy anomalies in YFe garnet discovered by Dillon (Abstr. 4812, 13450 of 1959) and attributed to rare earth ions are explained in terms of the crossovers or, most probably, near crossovers of the energy levels of the rare earth ions in the combined crystal and exchange fields. The central consequence deduced by the theory, independent of the detailed behaviour of the energy levels, is that $-H_\alpha(\Delta\theta_{1/2})^3 \cong \cong kTN'/M$, where H_α is the anisotropy field; $\Delta\theta_{1/2}$ the angular width of the peak; N' the concentration of rare earth ions at the crossover; M is the total magnetization; the result assumes $kT \gg$ level splitting at apparent crossover. This and other results appear to be in satisfactory agreement with the available experimental data. Crystals with giant anomalies have useful properties for adiabatic demagnetization experiments — the ferric–rare earth exchange field of 100 kOe can be effectively turned on or off by rotation of the magnetic moment of the crystal. In an appendix the validity of the molecular field approximation to the ferric–rare earth ion interaction is examined, and the approximation is found to be excellent. A further appendix discusses the question of crossing or noncrossing of energy levels in static fields.

539.2 : 538.27

6253 A STUDY OF THE VARIATION OF MAGNETIC MOMENT OF A SINGLE CRYSTAL OF YTTRIUM GARNET BY FERRIMAGNETIC RESONANCE AT 9350 Mc/s. J.Hervé and M.Sauzade.

C.R. Acad. Sci.(Paris), Vol. 250, No. 1, 82-4 (Jan. 4, 1960). In French.

Measurements have been made on a specimen of yttrium garnet ($5Fe_2O_3.3Y_2O_3$), having a line breadth of less than 5 Oe. An expression has been obtained between magnetic moment and r.f. magnetic field; using this, values for T_1 and T_2 of 7.8×10^{-8} secs have been obtained — in good agreement with values obtained by other workers. S.A.Ahern

539.2 : 538.27

6254 FERRIMAGNETIC RESONANCE OF POLYCRYSTALLINE NICKEL FERRITE-CHROMITES. H.Yonemitsu.
J. Phys. Soc. Japan, Vol. 14, No. 2, 231 (Feb., 1959).

As the chromium content was increased, the half-width ΔH remained about 400 Oe, but the absorption power and saturation magnetization were reduced. R.C.Kell

539.2 : 538.27

6255 ELECTRONIC PARAMAGNETIC RELAXATION AT LIQUID HELIUM TEMPERATURES. A.Bassompierre.
C.R. Acad. Sci. (Paris), Vol. 250, No. 7, 1208-10 (Feb. 15, 1960). In French.

In his discussion of spin–lattice relaxation processes Van Vleck (Abstr. 1669 of 1941) found that at low temperatures Raman phonon collisions with the spins, involving high energy phonons, did not contribute appreciably to the relaxation. For his calculation he used the equilibrium phonon distribution. This paper re-examines the problem using the Boltzmann equation describing the rate of change of this distribution. It is found that processes involving high energy phonons are effective for large external magnetic fields but not in zero field. J.M.Baker

539.2 : 538.27

6256 SPIN–LATTICE RELAXATION EFFECTS OBSERVED IN THE CONTINUOUS POWER SATURATION OF PARAMAGNETIC LINES. G.V.Marr and P.Swarup.
Canad. J. Phys., Vol. 38, No. 3, 495-503 (March, 1960).

The dependence of the conventional saturation parameter on the incident microwave power is considered for Lorentzian-shaped paramagnetic lines and applied to a study of the $(-\frac{1}{2} \rightarrow +\frac{1}{2})$ transitions of Cr^{+++} in $K_3Co(CN)_6$ and Gd^{+++} in $La(C_2H_5SO_4)_3.9H_2O$ at 9 kMc/s and 4.2°K. It is shown that the experimental observations may be explained on the basis of a spin–lattice transition probability which depends on spin–photon interactions. Values of the effective spin–lattice relaxation times are compared with pulse technique determinations and estimates of the corresponding phonon relaxation times are also given.

539.2 : 538.27

6257 COMMON ERROR MADE IN TREATING HYPERFINE EFFECTS IN ELECTRON PARAMAGNETIC RESONANCE STUDIES OF FREE RADICALS.
H.Zeldes, G.T.Trammell, R.Livingston and R.W.Holmberg.
J. chem. Phys., Vol. 32, No. 2, 618-19 (Feb., 1960).

The angular dependence of the hyperfine splitting for a pure p orbital is found to be $(3\cos^2\theta + 1)^{1/2}$ rather than the widely quoted value of $(3\cos^2\theta - 1)$. θ is the angle between the applied magnetic field and the symmetry axis of the orbital.

E.F.W.Seymour

539.2 : 538.27

6258 ELECTRON SPIN RELAXATION IN FERROMAGNETIC INSULATORS.
R.C.Fletcher, R.C.LeCraw and E.G.Spencer.
Phys. Rev., Vol. 117, No. 4, 955-63 (Feb. 15, 1960).

A phenomenological description of electron spin relaxation in ferromagnetic insulators is developed using the rate of energy transfer between the uniform precession, the spin waves, and the lattice. This leads to an equation of the motion containing T_{1e}, the relaxation time of the uniform precession to the lattice; T_{2k}, the relaxation time of the uniform precession to the k-th spin wave; and T_{1k}, the relaxation time of the k-th spin wave to the lattice. Experimental measurements at 6200 Mc/s are made on single crystal spheres of yttrium iron garnet to determine these times. In addition to measurements of resonance line width and high power saturation, these measurements include a frequency modulation method for measuring relaxation times. The theory provides an excellent fit to the experimental data over a range of surface roughness which varies the line width by a factor of 7.5. This enables the volume property, T_{1k}, to be determined experimentally in the presence of large surface scattering. The other volume property, T_{1e}, is determined on the smoothest surface and is found to constitute the lower limit for reducing the line width in the present materials at room temperature. The theory and techniques described should facilitate a better understanding of the basic relaxation mechanisms.

539.2 : 538.27

6259 DIRECT OBSERVATION OF OPEN MAGNETIC ORBITS. E.I.Blount.
Phys. Rev. Letters, Vol. 4, No. 3, 114-15 (Feb. 1, 1960).

When a steady magnetic field is applied to a metal, the conduction electrons trace out orbits in momentum space which may be closed or open. It is pointed out that open orbits may still show a quasi-periodic variation of momentum with time over part of the orbit, which can lead to resonance absorption effects similar to those shown by closed orbits. R.G.Chambers

539.2 : 538.27

6260 SPIN LATTICE RELAXATION IN YTTRIUM IRON GARNET. E.G.Spencer and R.C.Le Craw.
Phys. Rev. Letters, Vol. 4, No. 3, 130-1 (Feb. 1, 1960).

Relaxation times have been measured at low temperatures in a spherical sample grown from highly purified yttrium oxide. The relaxation time is 1.5×10^{-8} sec at 2.5°K and has a linear dependence on the reciprocal of the absolute temperature. The technique used to measure T_1 employs frequency modulation of the microwave source at a frequency much lower than $1/T_1$. The resultant modulation in M_z induces a voltage in a pick-up coil whose second harmonic amplitude depends upon the power absorbed in the sample and T_1. A separate measurement of the magnitude of the power absorbed enables T_1 to be determined. J.M.Baker

539.2 : 539.27

6261 ANOMALOUS SPIN LATTICE RELAXATION IN SOME COBALT SALTS AT LIQUID HELIUM TEMPERATURES.
J.van den Broek, L.C.van der Marel and C.J.Gorter.
Physica, Vol. 25, No. 5, 371-90 (May, 1959).

Paramagnetic relaxation experiments have been made on powders and single crystals of some cobalt salts by means of a Hartshorn bridge. A new method of measuring long relaxation times is described. A deviation parameter is introduced to describe the difference between the experimental dispersion and absorption curves and Casimir–du Pré theory. In cobalt ammonium sulphate the relaxation parameters depend on the parallel magnetic field in a remarkable way. Double relaxations and an anomalous dependence of the high frequency susceptibility on the magnetic field are found. The crystalline anisotropy of these phenomena is studied. In some cases a very strong dependence of the relaxation parameters on temperature (T^{-n}) is observed.

539.2 : 538.27

6262 SOME WEAK LINES IN THE PARAMAGNETIC RESONANCE SPECTRUM OF IMPURE MgO CRYSTALS.
J.H.E.Griffiths and J.W.Orton.
Proc. Phys. Soc., Vol. 73, Pt 6, 948-50 (June, 1959).

One set of lines is attributed to partially forbidden transitions of Fe^{3+} ions, and another set to Cr^{3+} ions associated with nearest neighbour positive ion vacancies. E.F.W.Seymour

539.2 : 538.27

6263 ELECTRON SPIN RESONANCE OF Gd^{3+} IN LANTHANUM FLUORIDE.
D.A.Jones, J.M.Baker and D.F.D.Pope.
Proc. Phys. Soc., Vol. 74, Pt 3, 249-56 (Sept., 1959).

Electron spin resonance in a single crystal of LaF_3 containing 0.01% Gd^{3+} shows three magnetically distinguishable ions per unit cell in a rhombic crystalline electric field which is consistent with a hexamolecular unit cell of symmetry C6/mcm. This is in disagreement with recent crystallographic measurements, but in agreement with the interpretation of the Faraday rotation given by Van Vleck and Hebb (1934). The parameters of the spin Hamiltonian are given. The crystal field splitting in zero magnetic field is of the order of 0.3 cm^{-1} which makes this a possible salt for maser operation in low magnetic field.

539.2 : 538.27

6264 ELECTRON SPIN RESONANCE ABSORPTION FOR POLYCRYSTALLINE SUBSTANCES.
J.W.Searl, R.C.Smith and S.J.Wyard.
Proc. Phys. Soc., Vol. 74, Pt 4, 491-3 (Oct. 1, 1959).

An exact expression was derived for the line shapes of polycrystalline specimens, using the following assumptions: (i) The line-shape for single crystal specimens is Lorentzian. (ii) The line-shape for a single crystal is independent of orientation. Good agreement is obtained with the experimental results of Gordy et al. [Proc. Nat. Acad. Sci. U.S.A., Vol. 44, No. 6, 613 (1958)]. S.A.Ahern

539.2 : 538.27 : 548.5

6265 SINGLE CRYSTAL TUNGSTATES FOR RESONANCE AND EMISSION STUDIES. L.G.Van Uitert and R.R.Soden.
J. appl. Phys., Vol. 31, No. 2, 328-30 (Feb., 1960).

A number of single crystal tungstates were prepared for paramagnetic resonance and emission studies. Compositions such as monoclinic $MgWO_4$, $ZnWO_4$, $CdWO_4$, and tetragonal $CaWO_4$, $SrWO_4$, and $BaWO_4$ containing paramagnetic ions of the transition and rare earth series were prepared. They were grown by dissolving the constituent oxides into an equimolar mixture of Na_2WO_4 and WO_3 at 1100 to 1250°C and cooling at 2 to 3°C per hour to 700°C. These crystals offer the advantages of one environment for the paramagnetic ions present, freedom from strain (hardness equal to that of iron), absence of random ordering effects, minimum effects from nuclear magnetic moments, and chemical stability. Large zero field splittings are observed in the monoclinic crystals, making them of interest for studies at high microwave frequencies. The tetragonal compositions are promising at the lower microwave frequencies and showed very narrow resonance lines. Line widths as low as 1.5 Mc/s were obtained in $CaWO_4$:Mn. $Na_{0.5}Y_{0.5}WO_4$ crystals, which have the scheelite structure, were also grown. Random ordering effects of monovalent sodium and trivalent yttrium, however, result in a non-homogeneous electrostatic environment throughout the crystals and hence cause broad paramagnetic resonance lines.

539.2 : 538.27

6266 THE SECOND MOMENT OF A PARAMAGNETIC ABSORPTION LINE WITH ALLOWANCE FOR FINE AND HYPERFINE STRUCTURE. U.Kh.Kopvillem.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 151-6 (Jan., 1960). In Russian.

Formulae for calculation of the reduced second moment of a paramagnetic resonance line and low-frequency paramagnetic absorption are derived taking into account crystalline electric field. A formula is given for calculation of the fine structure constants of nuclear and electron paramagnetic absorption using experimental values of the second moments of the absorption curve. Dependence of the spin—spin paramagnetic relaxation time on the interaction of the electronic magnetic moments with the internal electric field and nuclear magnetic moments is examined. As an example the order of magnitude of the spin—spin relaxation time in diamagnetic crystals with Mn^{2+} ion admixtures is evaluated.

539.2 : 538.27

6267 PARAMAGNETIC RESONANCE OF IMPURITIES IN CaF_2. J.M.Baker, W.Hayes and D.A.Jones.
Proc. Phys. Soc., Vol. 73, Pt 6, 942-5 (June, 1959).

The note presents a survey of the results of paramagnetic resonance measurements on crystals grown from melts of CaF_2 containing small quantities of 3d and 4f group paramagnetic impurities. Some of the impurities were not detected at all and others in very small quantities only. The ions which were incorporated substitutionally for Ca^{++} produce distortions of the crystal field which depend upon their valency and ion size. J.M.Baker

539.2 : 538.27

6268 SPIN RESONANCE OF CONDUCTION ELECTRONS IN InSb. G. Bemski.
Phys. Rev. Letters, Vol. 4, No. 2, 62-4 (Jan. 15, 1960).

This was observed in specimens with less than 10^{16} electrons/cm^3 at 1.2° and 4°K. The g value was found to be 50. K.W.Plessner

539.2 : 538.27

6269 PARAMAGNETIC RESONANCE OF EXCHANGE-COUPLED Cr^{3+} PAIRS IN RUBY.
L.Rimai, H.Statz, M.J.Weber, G.A.deMars and G.F.Koster.
Phys. Rev. Letters, Vol. 4, No. 3, 125-8 (Feb. 1, 1960).

A large number of weak lines are observed in the electron spin resonance spectrum of specimens of ruby containing between 0.05 and 1% Cr^{+++} ions. Many of these lines are strongly concentration dependent and decrease in intensity with decreasing temperature. Measurement of the angular dependence of some of the lines at 10 and 16 kMc/s enable a tentative assignment of them to pairs of Cr^{+++} ions on the crystal axis with $J \simeq 250$ cm^{-1}. There are also lines which may be due to weaker exchange of both ferro- and antiferromagnetic type with other neighbours. J.M.Baker

539.2 : 538.27

6270 DOUBLE-QUANTUM ELECTRON SPIN RESONANCE TRANSITIONS OF NICKEL IN MAGNESIUM OXIDE.
J.W.Orton, P.Auzins and J.E.Wertz.
Phys. Rev. Letters, Vol. 4, No. 3, 128-9 (Feb. 1, 1960).

The Ni^{++} ions are present in the crystal in approximately cubic surroundings, the ground state having effective spin S = 1. At 77°K the spectrum consists of an isotropic broad line with a sharp line superimposed on its centre. The width of the broad line may be attributed to the presence of small distortions in the MgO lattice; the sharp line has a width similar to that of the lines from other impurities in the same crystal. The narrow line is attributed to a double quantum jump between the $S_z = +1$ and $S_z = -1$ levels. As expected the line intensity increases with the square of the microwave power. As a further test of the double quantum interpretation a sample was arranged to be simultaneously in two microwave fields of slightly different frequency and simultaneous absorption of one quantum of each frequency was observed. J.M.Baker

539.2 : 538.27

6271 NUCLEAR QUADRUPOLE RESONANCE SPECTRA OF N^{14} IN UREA CRYSTAL.
T.Chiba, M.Toyama and Y.Morino.
J. Phys. Soc. Japan, Vol. 14, No. 3, 379-80 (March, 1959).

This was studied over the temperature range from dry ice temperature to room temperature. At the low temperature end, a fairly strong asymmetrical signal is observed at 2.87 Mc/s. This decreases in intensity and shifts to lower frequency with increasing temperature. From the shape and the strength of the low temperature signal, it is concluded that this was the high-frequency component of a doublet; the other component is expected to occur at about 2.6 Mc/s, but has not been observed. S.A.Ahern

539.2 : 538.27

6272 H.F.S. OF F^{19} IN THE ELECTRON PARAMAGNETIC RESONANCE OF Mn:ZnF_2.
A.M.Clogston, J.P.Gordon, V.Jaccarino, M.Peter and L.R.Walker.
Phys. Rev., Vol. 117, No. 5, 1222-35 (March 1, 1960).

An experimental and theoretical re-examination of the F^{19} "super-h.f.s." in the electron paramagnetic resonance of Mn^{2+} as a dilute, substitutional impurity in ZnF_2 was made. The observation of anomalous spectra at 23 kMc/s has necessitated a modification of the phenomenological theory first offered by Tinkham (Abstr. 8312-13 of 1956). Precise measurement of all of the h.f.s. interaction constants, in conjunction with the new theory, allows direct comparison to be made with the results of the n.m.r. experiments of F^{19} in MnF_2. The agreement now found is most satisfactory. The theory of the origin of the F^{19} h.f.s. is discussed in the light of recent work of Mukherji and Das, Marshall, and Keffer et al. The Mn^{55} h.f.s. was measured and found to be anisotropic. This, in conjunction with Mn^{55} specific heat measurements in antiferromagnetic MnF_2, enables one to compute the magnetization of a sublattice at T = 0°K.

539.2 : 538.27

6273 ELECTRON-NUCLEUS DOUBLE RESONANCES OF F-CENTRES IN KCl AT ROOM TEMPERATURE.
H.Seidel and H.C.Wolf.
Naturwissenschaften, Vol. 46, No. 21, 597-8 (1959). In German.

Resonance measurements at room temperature were made with KCl crystals containing 10^{18} F-centres cm^{-3} by the simultaneous application of a 9.4 kMc/s field to obtain partial saturation of electron spin resonance, and a field of 1-15 Mc/s for nuclear spin resonance in a magnetic field of 3365 Oe. J.Franks

539.2 : 538.27

6274 ANTIFERROMAGNETIC EXCHANGE INTERACTIONS BETWEEN Mn^{2+} IONS IN MgO.
B.A.Coles, J.W.Orton and J.Owen.
Phys. Rev. Letters, Vol. 4, No. 3, 116-17 (Feb. 1, 1960).

The interactions were measured for an isolated nearest-neighbour pair of Mn ions and also a next-nearest-neighbour pair. Resonance was observed for transitions between the Zeeman components belonging to a state of total spin S = 1. The results are discussed in terms of a spin Hamiltonian and values for the constants in this are deduced. The values of the exchange integrals do not agree with similar results obtained from the susceptibility of MnO. Tentative explanations are given for the discrepancy.

D.J.Oliver

539.2 : 538.27 : 539.14

DYNAMIC ORIENTATION OF NUCLEI BY FORBIDDEN TRANSITIONS IN PARAMAGNETIC RESONANCE.
See Abstr. 5654-5

539.2 : 538.27

6275 MEASUREMENT OF SPIN LATTICE RELAXATION TIMES OF Cu^{63} AS A FUNCTION OF TEMPERATURE. B.C.de Tornd.
C.R. Acad. Sci. (Paris), Vol. 250, No. 3, 512-14 (Jan. 18, 1960). In French.

A spin echo apparatus has been constructed to measure the spin–lattice relaxation times T_1 of metals. The effect on the precision of measurements is discussed of the precautions taken in the experiment. Preliminary results are given of a study of the relaxation time of the Cu^{63} nuclear spins as a function of temperature. J.M.Baker

539.2 : 538.27

6276 NMR STUDIES ON 1-METHOXYVINYL ESTERS. M.Saunders, J.Plostnieks, P.S.Wharton and H.H.Wasserman.
J. chem. Phys., Vol. 32, No. 1, 317-18 (Jan., 1960).

The effects of several substitutional groups (R.COO–) on the chemical shifts and coupling constants of the methylene protons were measured, and are discussed. E.F.W.Seymour

539.2 : 538.27

6277 CONCENTRATION DEPENDENCE OF THE POLARIZATION AND RELAXATION TIME OF Al^{27} NUCLEI IN RUBY. R.D.Spence and J.A.Cowen.
J. chem. Phys., Vol. 32, No. 2 624-5 (Feb., 1960).

It has been shown previously (Abstr. 7316 of 1958) that in a system containing weakly coupled electronic and nuclear spins with significantly different relaxation times, the nuclear spin system population distribution can be disturbed by induced electronic transitions leading under the appropriate conditions to nuclear emission or an enhanced nuclear absorption signal. Measurements were made of the concentration dependence of polarization relaxation time and enhancement for the Al^{27} nuclear transitions. The experiments were made on ruby rods, oriented with the angle between the c-axis and the external magnetic field equal to 30°, placed so that one end of the rod dipped into a microwave cavity while the other was surrounded by the coil of an n.m.r. spectrometer. The system was contained in an unsilvered glass Dewar vessel and maintained at 4.2°K. Data were obtained from samples containing 0.01, 0.1 and 0.25% chromium. In the first two samples, the enhancement was approximately 30, but in the 0.25% sample enhancement was very slight. The relaxation times are: 0.01%, 26 sec; 0.1%, 2.6 sec; and 0.25%, $\ll$ 1 sec. An auxiliary experiment using a pulsed free induction n.m.r. apparatus in conjunction with the microwave system gave substantially similar results. S.A.Ahern

539.2 : 538.27

6278 NUCLEAR MAGNETIC RESONANCE FREQUENCY SHIFT OF ^{59}Co IN CoF_2. T.Moriya.
J. Phys. Chem. Solids, Vol. 11, No. 1-2, 175-6 (Sept., 1959).

The gyromagnetic ratio of Co^{59} in CoF_2 is larger by 20% than in a diamagnetic crystal. Half of this change arises from the hyperfine field of the Co^{2+} spin induced by the external field. The remainder of the shift arises from the magnetic interaction between the nuclear spin and the orbital magnetic moment of the Co^{2+} ion produced by the applied field. Details of the calculation are given. D.J.Oliver

539.2 : 538.27

6279 NUCLEAR MAGNETIC RESONANCE OF SOLID HYDROGEN (67-86% ORTHO) AND SOLID DEUTERIUM (33% AND 55% PARA). G.W.Smith and R.M.Housley.
Phys. Rev., Vol. 117, No. 3, 732-5 (Feb. 1, 1960).

The method of Cunningham, Chapin, and Johnston was used to produce the high concentrations ortho H_2 and para D_2. The temperature (T_λ) of appearance of side peaks associated with the removal of rotational degeneracy in H_2 was found to shift to 2.18°K for 86% ortho as compared to a value of 1.6°K for the normal concentration. The data for T_λ versus concentration were found to join smoothly to the previous lower concentration work of Sugawara et al. (Abstr. 7250 of 1955). In addition an interesting hysteresis phenomenon was observed for H_2. It was noted that the temperature of appearance of the side peaks when the H_2 is cooled is some 0.15°K lower than the temperature of their disappearance when the temperature is slowly raised. In the case of deuterium, peaks were observed for either 33% or 55% para D_2 at temperatures down to 0.9°K. T_1 was measured roughly for the two concentrations. For n-D_2, T_1 was found to be 7.6 ± 3 sec. This compares well with the theoretical value of 8 sec given by Moriya and Motizuki. For 55% para-D_2, a value of 3 ± 1 sec was found. The theory of Moriya and Motizuki gives 5 sec.

539.2 : 538.27

6280 NUCLEAR MAGNETIC RESONANCE IN DILUTE Cu–Mn ALLOYS. W. van der Lugt, N.J.Poulis and W.P.A.Hass.
Physica, Vol. 25, No. 2, 97-110 (Feb., 1959).

Cu^{63} nuclear magnetic resonance measurements were performed in dilute Cu–Mn alloys. The Cu spin-lattice relaxation time showed deviations from the 1/T law. The line width was measured as a function of the external field, the temperature and the concentration. The results were compared with Yosida's theory (Abstr. 7220 of 1957) concerning the polarization of the conduction electrons. An antiferromagnetic ordering is expected to set in low temperatures.

539.2 : 538.27

6281 PROTON MAGNETIC RESONANCE STUDY OF THE STRUCTURE OF BARIUM CHLORIDE DIHYDRATE. A.A.Silvidi and J.W.Macgrath.
J. chem. Phys., Vol. 32, No. 3, 924-6 (March, 1960).

The proton magnetic resonance absorption spectrum of barium chloride dihydrate was obtained experimentally at room temperature using a Pound-Watkins spectrometer. The results indicate that there are four pairs of p-p directions in the crystal. The p-p distance and direction angles of these four pairs are: 1.58 A, $\alpha_0 = 90°$, $\beta_0 = 58°$, $\gamma_0 = 148°$; 1.58 A, $\alpha_0 = 90°$, $\beta_0 = 58°$, $\gamma_0 = 32°$; 1.59 A, $\alpha_0 = 148°$, $\beta_0 = 58°$, $\gamma_0 = 90°$; 1.57 A, $\alpha_0 = 32°$, $\beta_0 = 58°$, $\gamma_0 = 90°$. The experimental error for the p-p distance is ± 0.02 A and for the direction angles it is ± 4°. By using experimental data, X-ray analysis, and the concept of hydrogen bonding the positions of the hydrogen atoms were determined.

539.2 : 538.27

6282 ON THE NUCLEAR QUADRUPOLE RESONANCE LINE-WIDTH IN SOLIDS SUBJECTED TO HIGH-ENERGY IRRADIATION. J.Depireux, J.Duchesne and A. Van de Vorst.
Bull. Acad. Roy. Belgique Cl. Sci. Vol. 64, No. 8, 693-701 (1958). In French.

A study of the line width and intensity of the pure quadrupole magnetic resonance absorption of Cl^{35} and Br^{79} in sodium chlorate and paradichlorobenzene and the effect of gamma and neutron irradiation. For γ irradiation of $NaClO_3$ the line width is constant up to a dose of about 10^8 r and then rises. The intensity falls exponentially to 20% at 10^8 r and then remains constant. Neutron irradiation is much less efficient For γ irradiation of p-$Br_2C_6H_4$ the intensity only falls to 50% and no line width increase occurs. These results are thought to be due to induced macroscopic strains rather than perturbation of local field gradients. A mechanism of radio saturation by "auto-protection" is discussed. J.G.Powles

539.2 : 538.27

6283 N^{14} PURE QUADRUPOLE RESONANCES OF ACETONITRILE AND HYDROCYANIC ACID. H.Negita, P.A.Casabella and P.J.Bray.
J. chem. Phys., Vol. 32, No. 1, 314-15 (Jan., 1960).

Either of two spectra, differing in electric field gradient asymmetry parameter but not in coupling constant, may be observed at 77°K in CH_3CN, depending on the cooling rate. The spectrum of HCN changes between 77°K and 195°K, confirming X-ray evidence of a phase change. E.F.W.Seymour

539.2 : 538.27

6284 ZEEMAN SPLITTING OF NUCLEAR QUADRUPOLE LEVELS IN CUPRITE. H.L.Cox, Jr and D.Williams.
J. chem. Phys., Vol. 32, No. 2, 633-4 (Feb., 1960).

A single crystal was used and it was established that the O–Cu–O bond is the axis of electric symmetry. The asymmetry parameter η was found to be $< 1.2 \times 10^{-3}$. D.J.Oliver

539.2 : 538.27

6285 DEPENDENCE UPON VOLUME OF NUCLEAR QUADRUPOLE INTERACTIONS IN CRYSTALS. R.A.Bernheim and H.S.Gutowsky.
J. chem. Phys., Vol. 32, No. 4, 1072-81 (April, 1960).

The electric quadrupole splitting of the Na^{23} nuclear magnetic resonance was measured in single crystals as a function of pressure and temperature for $NaNO_3$, and as a function of temperature for

$NaBrO_3$. It is found that the electric field gradient at the sodium nuclei varies as $V^{-3.8}$ in $NaNO_3$ and as $V^{-2.0}$ in $NaBrO_3$. These results, together with the previously reported $V^{-1.9}$ dependence for Na^{23} in $NaClO_3$, are compared with theoretical values computed from point charge models for the crystal lattices. It is concluded that the large volume dependence in $NaNO_3$ arises from the anisotropic thermal expansion and compressibility of the hexagonal crystal plus the retention of size and configuration of the NO_3^- group. The experimental results for $NaClO_3$ can be explained in the same manner, assuming a rigid ClO_3^- group; however, this model does not account for the V^{-2} dependence of the Na^{23} quadrupole coupling observed in $NaBrO_3$. The assumed rigidity of the ClO_3^- group is supported by the small volume dependence, $V^{-0.30}$, found for the Cl^{35} quadrupole coupling in $NaClO_3$, and also by calculations of the interionic contribution to the field gradient at the chlorine nuclei in $NaClO_3$ and $KClO_3$.

539.2 : 538.27

6286 NUCLEAR RELAXATION VIA QUADRUPOLE COUPLING. R.L.Mieher.

Phys. Rev. Letters, Vol. 4, No. 2, 57-9 (Jan 15, 1960).

A theoretical and experimental investigation of several problems of nuclear relaxation due to quadrupole coupling. It is shown that T_1 is isotropic both theoretically and experimentally. The results on a number of III-V compounds favour a two phonon rather than a four phonon process and are in agreement with theory (Abstr.2300 of 1955). The spin dependence of T_1 is also clarified.

J.G.Powles

MECHANICAL PROPERTIES OF SOLIDS

539.3

6287 RESISTANCE STRAIN GAUGES — ACCURACY OBTAINABLE WITH GAUGE BODIES MADE OF SYNTHETIC MATERIALS AND METALS. C.Rohrbach.

Arch. tech. Messen, No. 281, (Ref. J 133-1), 125-8 (June, 1959). In German.

Details are given of some of the mechanical properties of Araldite casting resin B, a material frequently employed to construct miniature load cells of about 4 mm diameter by 2.5 mm length carrying electrical resistance strain gauges. The limit of proportionality of the material occurs at a strain of 10^{-3} and fracture occurs at 19.4×10^{-3}; the elastic modulus is 360 kilopond/mm^2* and permanent deformation starts at about 3 kp/mm^2. The elastic modulus falls rapidly with increase of temperature reaching a value of about 1 Kp/mm^2 at 120° C. At room temperature, considerable creep occurs and is proportional to the applied stress. The material has a high electrical insulation, but it will absorb between 0.1 and 0.14% of moisture in a week. Tests with complete load cells reflect the characteristics of the body material. [*kilopond = kilogram weight].

A.C.Whiffin

539.3

6288 THE EVALUATION OF POISSON'S RATIO AND THE MODULUS OF MATERIALS OF A LOW TENSILE RESISTANCE BY THE BRAZILIAN (INDIRECT TENSILE) TEST WITH PARTICULAR REFERENCE TO CONCRETE. G.Hondros.

Austral. J. appl. Sci., Vol. 10, No. 3, 243-68 (Sept., 1959).

The Brazilian or indirect tensile test is a convenient and established technique for the assessment of the tensile strength of concrete, a material which, because of its low tensile resistance, presents testing difficulties with which conventional methods cannot cope. This paper describes, inter alia, the analysis of the circular specimen loaded to conform to the accepted practical recommendations for the Brazilian test, and its extension to yield a direct method of evaluating Poisson's ratio and the modulus of cement mortars and concrete. Steel specimens were employed to assess the validity of the experimental techniques and to select an acceptable specimen shape for use in destructive tests on concrete.

539.3

6289 SIMPLE ROTARY DYNAMIC TESTING MACHINE. A.N.Gent.

Brit. J. appl. Phys., Vol. 11, No. 4, 165-7 (April, 1960).

A test machine is described for determining the dynamic shear properties of rubber-like materials. It imposes a simple shear deformation, the direction of which is continuously rotated. The observations are easily made, and enable the dynamic shear modulus and damping factor to be determined rapidly; moreover, a relatively wide frequency range seems feasible. The instrument therefore appears suitable for general application. Measurements on a soft butyl rubber vulcanizate are described and compared with observations of free torsional oscillations. Good agreement is obtained. The test-piece is subjected to a rotating shear of constant amplitude, and hence the elastically-stored energy is held constant. The observed energy dissipation therefore confirms a hypothesis of Greenwood and Tabor (Abstr. 4500 of 1958), that dissipation may occur under such conditions, and indicates the limitations of the "hysteresis" concept that the dissipated energy is a constant fraction of the elastically-stored energy.

539.3 : 539.2 : 537.2

6290 AN ALTERNATIVE TRANSFORMATION FOR THE ELASTIC AND PIEZOELECTRIC CONSTANTS OF ANISOTROPIC MEDIA. R.Bechmann.

Acta cryst., Vol. 13, Pt 2, 110-13 (Feb., 1960).

A new form for the transformations of the elastic and piezoelectric constants is derived, introducing general Christoffel moduli $\Gamma_t(p)$ (t = 1...6) for the transformation of the elastic stiffnesses, and general piezoelectric moduli $E_i(p)$ (i = 1, 2, 3) for the transformation of the piezoelectric stress constants, in all cases p = 1...6.

539.2 : 537.2 : 539.3

AN ALTERNATIVE TRANSFORMATION FOR THE PIEZOELECTRIC CONSTANTS OF ANISOTROPIC MEDIA. See Abstr. 6290

539.3

6291 ELASTIC MODULI OF FACE-CENTRED CUBIC COBALT. R.D.Dragsdorf.

J. appl. Phys., Vol. 31, No. 2, 434-6 (Feb., 1960).

From the relationships between the longitudinal and transverse wave velocities propagated in different directions in hexagonal and cubic Co, an expression is derived from which the elastic moduli of cubic Co above 420° C can be deduced from that of hexagonal Co at room temperature. The results, in terms of 10^{12} dynes/cm^2 are $C_{11} = 3.037 \pm 0.023$; $C_{12} = 1.543 \pm 0.023$ and $C_{44} = 0.747 \pm 0.004$.

H.J.H.Starks

539.3

6292 ON THE NATURE OF THE VARIATION OF YOUNG'S MODULUS DURING THERMAL TREATMENT OF SINGLE-PHASE, NICKEL-BASE ALLOYS.

V.K.Kritskaya, G.V.Kurdyumov and Yu.A.Osip'yan.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 3, 550-2 (Nov. 21, 1959). In Russian.

It was shown that the Young's modulus, E, of pure Ni, and of 10% Cu–Ni, 10% Co–Ni and 3.5% Mo–Ni alloys, annealed at 600-700° C and cooled slowly to room temperature, was much lower than that of the same alloys quenched from temperatures ≥ 300° C, and that the temperature dependence of E was also affected by the thermal history of these materials. It was postulated that these differences were not due to different magnitude of the metallic bond forces, but were associated with the effect of the sub-grain structure of the solid solutions studied on the mechanostrictive deformation of ferromagnetic specimens.

M.H.Sloboda

539.3

6293 INVESTIGATION OF THE MECHANICAL PROPERTIES OF METALS AT LIQUID HELIUM TEMPERATURES.

O.V.Klyavin and A.V.Stepanov.

Fiz. tverdogo Tela, Vol. 1, No. 11, 1733-5 (Nov., 1959). In Russian.

Low-temperature measurements of stress versus strain were made with a number of metals, alloys and plastics. Explicit results are given for aluminium only, involving samples which had or had not been annealed. Strain–stress graphs were obtained at 1.3, 1.6 and 4.2° K. Further results which were obtained at atmospheric temperature are given. In some low-temperature experiments the sample was pre-stressed at atmospheric temperature. Results show a marked effect of temperature on the mechanical behaviour of aluminium; in particular its tensile strength is increased to 150 kg/mm^2 at low temperatures. With some alloys the lowering of temperature has the effect of increasing the elastic limit.

R.Eisenschitz

539.3

6294 EFFECT OF ELECTRON IRRADIATION AND SUBSEQUENT THERMAL TREATMENT ON YOUNG'S MODULUS OF COPPER. A.Sosin and L.L.Bienvenue.

J. appl. Phys., Vol. 31, No. 2, 249-52 (Feb., 1960).

Measurements of Young's modulus of copper following high energy electron irradiation and subsequent heat treatment are reported. The modulus is observed to increase following short exposures at −190°C in three separate temperature regions, centred at approximately −45°, −5°, and +80°C. These modulus increases are discussed in terms of the various point defects created by the bombarding electrons.

539.3

6295 DEPENDENCE ON TEMPERATURE OF ELASTIC MODULI OF TIN. P.J.Reddy and S.V.Subrahmanyam.

Nature (London), Vol. 185, 29 (Jan. 2, 1960).

Specimen rods of rectangular and circular cross-section were cut from 99% pure tin and tests in vibration in a composite piezoelectric oscillator working within the range 100-145 kc/s. The tests were made within the range 0-100°C and Young's modulus and the rigidity modulus were determined. The elastic moduli decreased with rise of temperature, a sudden change in the gradient of the curves occurred at about 18°C in both cases due to structural changes. The Young's modulus curve also showed another change of gradient at 80°C, probably as a result of stress relaxation at the grain boundaries. A.C.Whiffin

539.3 : 539.2

ELASTIC CONSTANTS OF CaF_2 AT LOW TEMPERATURES.
See Abstr. 6018

539.3

6296 ANELASTICITY OF NITROGEN IN α-IRON. H.U.Åström.

Ark. Fys., Vol. 14, Paper 23, 383-6 (1958).

Earlier measurements by the author using a relaxation method showed a non-linear relationship between the internal friction and the concentration of solute N_2 in α-Fe. Later measurements by other workers using the usual torsional pendulum gave a linear relationship. The present paper describes some additional results and shows that most of the discrepancy can be accounted for by the influence of temperature. H.J.H.Starks

539.3

6297 INTERNAL FRICTION OF COLD-WORKED GOLD AND COPPER AT LOW TEMPERATURES.

R.R.Hasiguti and S.Okuda.

Sci. Pap. Inst. Phys. Chem. Res.(Tokyo), Vol. 53, 265-70 (Dec., 1959).

The internal friction of Au and Cu, deformed at room temperature and at liquid nitrogen temperature, was measured from -180° to 80°C by the inverted torsion pendulum method. Three peaks appear in the internal friction versus temperature curve. These peaks grow and decay in the process of annealing. To explain these peaks, a theory based on the point defect–dislocation interaction is proposed.

539.3

6298 MICROCRACKS, AND THE STATIC AND DYNAMIC ELASTIC CONSTANTS OF ANNEALED AND HEAVILY COLD-WORKED METALS. J.R.Bristow.

Brit. J. appl. Phys., Vol. 11, No. 2, 81-5 (Feb., 1960).

The existence of sub-microscopic cracks in heavily cold-worked metals has been suggested in explanation of the very large discrepancies in dislocation densities estimated from changes in density and electrical resistivity, and release of stored energy on annealing such materials. It is shown that microcracks will produce changes in the elastic constants of a material comparable with — but somewhat larger than — the change in electrical resistivity, rather than with change in density. Measurements have been made, both statically and dynamically, of Young's modulus, the shear modulus and Poisson's ratio for annealed and heavily cold-worked aluminium, copper and nickel. No changes in moduli were found that could be ascribed to the presence of microcracks. An unexpected result is a very large and consistent difference between the bulk moduli, and Poisson's ratio, determined statically and dynamically — a difference very much greater than can be accounted for by the usual thermodynamic relationship between isothermal and adiabatic moduli.

539.3

6299 CRYSTALLINE TRANSITIONS AND MECHANICAL RESONANCE DISPERSION IN VINYL AND ETHYL STEARATE. E.R.Fitzgerald.

J. chem. Phys., Vol. 32, No. 3, 771-86 (March, 1960).

Dynamic shear compliance measurements in vinyl and ethyl stearate yield results depending critically on the particular crystalline modification in which these materials exist at the time of measurement. When first crystallized from the melt the materials are in a metastable state and only a few very small resonance dispersions are found in the range 50 to 5000 c/s. At later times many large resonances occur; the largest is in the vicinity of 300 c/s for both vinyl and ethyl stearate. While vinyl stearate is in its metastable state (about 60 days) a reversible transition takes place at $24.8_5 \pm 1_5$°C such that above this temperature there are no resonances from 50 to 600 c/s, but below the transition point the large resonance near 300 c/s always appears. A break in the slope of density–temperature curves for vinyl stearate occurs between 25 and 24°C indicating that a transition occurs in the vinyl stearate while in its β form (with the molecules tilted with respect to the planes formed by the terminal groups). X-ray powder diffraction photographs show no changes in the long spacing between planes so the transition must involve alterations in cross-sectional packing of the chains or a change from a monoclinic to triclinic unit cell rather than a variation in angle of tilt. While the details of the crystalline modification at 24-25°C are not as yet sufficiently clear to define a specific mechanisms for the resonance phenomena, the results do prove conclusively that the dispersions are intimately connected with the crystalline state of the material. Eventually a kind of mechanical spectroscopy may be evolved yielding information on the actual crystalline state of solids in much the same way that electromagnetic spectra now aid in determinations of molecular structures.

539.3

6300 ON THE PROPAGATION OF DEFORMATION BANDS IN HOMOGENEOUS ISOTROPIC MATERIAL.

J.C.Bauwens, G.A.Homès and R.Pankowski-Fern.

C.R. Acad. Sci. (Paris), Vol. 250, No. 2, 290-2 (Jan. 11, 1960). In French.

The behaviour of a material subjected to steadily increasing tension is considered, the behaviour of the material being defined by the Huber Hencky and von Mises' criteria. The plastic deformation due to point tension is propagated over the surface of a cone having its apex at the point, its axis parallel to the simple tension and with a semi-vertical angle of 55°. This angle is derived from $(1/\sqrt{3}) \simeq$ cosine 55°. The theoretical treatment is not given in full, but the conclusion is illustrated by photographs showing deformations of test specimens. A.C.Whiffin

539.3

6301 THE THERMODYNAMICS OF IRREVERSIBLE PROCESSES OF PLASTIC DEFORMATION. N.S.Fastov.

Dokl. Akad. Nauk SSSR, Vol. 130, No. 3, 541-4 (Jan. 21, 1960). In Russian.

Small deviations from equilibrium are considered in a relaxing body subjected to shear stresses. Expressions are obtained for the free energy, the entropy, the stress tensor and the hardening energy, allowance being made for change in the relaxation energy with time. The change in hardening energy with time, and quasi-stationary processes, are also dealt with. See also Abstr. 7548 of 1950. R.F.S.Hearmon

539.3

6302 A STUDY OF PLASTIC DEFORMATION OF METALS UNDER CYCLIC LOADING. V.A.Parfenov.

Fiz. Metallov i Metallovedenie, Vol. 6, No. 2, 359-62 (1958). In Russian.

The article describes an attempt to follow the process of twinning due to deformation. Electropolished strips of a face-centred cubic nickel alloy were subjected to cyclic bending through specified angles. After each quarter cycle the specimens were examined by oblique illumination under an optical microscope. Each cycle increased the number of slip lines and after about 10 complete cycles twin formation was observed. Ordinary fatigue experiments were also carried out on another face-centred cubic alloy, and the fractured regions were then examined under the microscope. Twins were found only in those specimens which have been deformed at high stresses (30-35 kg/mm^2). M.G.Priestley

539.3

6303 MAXIMUM DEFORMATION BY STRESS AND ANGLE OF BENDING. Yu.E.Bondarev.

Fiz. Metallov i Metallovedenie, Vol. 6, No. 2, 362-4 (1958). In Russian.

The paper describes experiments on strip specimens of seven metals to investigate the relation between the maximum deformation, the angle of bend, Young's modulus, and the ratio of the width of the specimen to its thickness. M.G.Priestley

539.3

6304 THE NATURE OF THE FLOW PLATEAU OF PURE IRON AND CARBON STEELS.

D.M.Vasil'ev and L.V.Kozhevnikova.

Fiz. tverdogo Tela, Vol. 1, No. 8, 1316-19 (Aug., 1959). In Russian.

The method described in a previous paper (Abstr. 10315 of 1959) was used to study the behaviour of the matrix and friable "skeleton" regions during plastic deformation and to determine the "structural" stresses acting on the A and B regions. Results obtained disprove Koster's hypothesis relating to the load relief of the cementite skeleton (in steel) when the flow plateau is reached. F.Lachman

539.3

6305 THE NATURE OF "FLOW AREAS" IN METALS. N.N.Davidenkov and E.I.Brainin

Fiz. tverdogo Tela, Vol. 1, No. 9, 1479-83 (Sept., 1959). In Russian.

The authors measured directly the deformation of small areas of a metal surface and counted the grain density in these areas both before and after deformation. The results show that all the deformation produced in the flow area is due to slip within the grains, thus disproving the hypothesis of slip (viscous flow) at the grain boundaries. M.G.Priestley

539.3

6306 FACTORS AFFECTING THE DUCTILITY AND STRENGTH OF NaCl SINGLE CRYSTALS TESTED IN FLEXURE. C.A.Stearns, A.E.Pack and R.A.Lad.

J. appl. Phys., Vol. 31, No. 2, 231-4 (Feb., 1960).

An experimental investigation has revealed that the initial deformation of NaCl single crystals is anelastic rather than Hookean. This anelastic deformation is manifested by a low slope foot in the load-deflection curve. The magnitude of the foot is dictated by the pretreatment given the specimen. Treatments which increase or decrease the fresh dislocation density respectively increase or decrease the length of the initial anelastic foot. The order of increasing ductility and strength with specimen pretreatment was found to be, (1) heated at 135°C, (2) as cleaved, (3) coated with silver, (4) heated at 135°C and then water polished, (5) water polished and then coated with silver, (6) water polished, (7) water polished and then heated at 135°C, (8) annealed at 700°C and, (9) annealed at 700°C and then water polished. The experimental results have been discussed in terms of the role played in deformation and fracture by surface cracks, grown-in dislocations and fresh dislocations.

539.3

6307 EVIDENCE FOR A MACROSCOPIC INHOMOGENEITY OF STRENGTH IN THE DEFORMATION BY TENSION OF PURE NICKEL. K.Kolb and E.Macherauch.

Naturwissenschaften, Vol. 46, No. 22, 624 (1959). In German.

The lattice strains induced by plastic deformation were determined from line-broadening in X-ray powder photographs. The stress-strain curve derived from these measurements represented the behaviour of the surface of the specimen only, and was different from the stress-strain curve for the specimen as a whole.

B.T.M.Willis

539.3

6308 A MOLECULAR APPROACH TO THE PROBLEM OF VISCOELASTICITY. A.H.Nissan and H.G.Higgins.

Nature (London), Vol. 184, 1477-8 (Nov. 7, 1959).

Young's modulus E was measured, at different degrees of substitution of OH groups by acetylation, in the case of a moderately beaten high α-cellulose eucalypt pulp. Results are broadly consistent with the hypothesis that mechanical properties of cellulosic materials are a function of the number n of hydrogen bonds per unit volume with the implication that E varies as $n^{1/3}$. J.G.Oldroyd

539.3

6309 RELAXATION OF STRESS AND CREEP AS PROCESSES OF VISCOUS FLOW. N.S.Fastov.

Dokl. Akad. Nauk SSSR, Vol. 130, No. 1, 64-7 (Jan. 1, 1960). In Russian.

Equations relating elastic and viscous flow are formulated in which Maxwell's relaxation time is replaced by a spectrum of relaxation times. The discrepancy between these equations and experiments with creep in metals is discussed; it is attempted to associate this discrepancy with lattice defects and with inhomogeneities of the crystals. R.Eisenschitz

539.4

6310 MEMBRANE CREEP OF CIRCULAR PLATES. F.K.G.Odqvist.

Ark. Fys., Vol. 16, Paper 9, 113-18 (1959).

The rate of plastic deformation of a thin circular plate under constant transverse load is calculated approximately when the ratio of rates of strain to stresses varies as a power of an "effective stress" defined at each point. The case of the plastic-rigid solid can be deduced as a limiting case. J.G.Oldroyd

539.4

6311 CREEP IN SINGLE CRYSTALS OF ZINC IN THE PRESENCE OF A SURFACE-ACTIVE LOW MELTING-POINT METALLIC MELT. V.A.Labzin and V.I.Likhtman.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 3, 536-9 (Nov. 21, 1959). In Russian.

The authors studied the creep rate of single crystals of zinc as a function of stress at several temperatures in the range 550-620°K, both with and without a thin layer of liquid tin on the surface of the zinc crystal. The initial creep velocity and viscosity were measured as a function of the applied shear stress. No threshold for the onset of plastic flow was found. When the yield point was reached the viscosity decreased and the initial creep velocity increased sharply. The same quantities were then measured when the crystal was covered by a thin layer of tin. The viscosity dropped by a factor of ~ 2. The activation energies for viscosity were measured as 10 and 6.6 kcal/mol in air and tin respectively, but a purer zinc crystal gave 5.5 kcal/mol in air. It is concluded that the "plastification" effect already observed with organic surface-active agents can also occur with metal media when dislocation micro-cracks are not formed in the metal surface. M.G.Priestley

539.4

6312 A STUDY OF THE EFFECT OF A PRELIMINARY COLD DEFORMATION ON CREEPING.

G.I.Nosova and V.M.Rozenberg.

Fiz. Metallov i Metallovedenie, Vol. 6, No. 2, 321-5 (1958). In Russian.

Fe–Ni–Cr–Co solid solutions (~ 41% Ni, ~ 14% Cr, 0-10-20% Co, remainder Fe, with traces of C and Mn) were investigated, both in the deformed and the annealed state. Below 600°C, the structure was found to be the main factor determining the behaviour of these solutions during slow plastic deformations. At higher temperatures, it is the chemical composition of the solid solution that becomes the decisive factor. The creep rate of specimens strengthened by cold deformation (but previously not stabilized) increases sharply in the range of recrystallization temperatures. F.Lachman

539.4 : 541.18

6313 THE CHANGE IN THE MECHANICAL PROPERTIES OF TIN SINGLE CRYSTALS UNDER THE INFLUENCE OF A STRONG ADSORPTION ACTIVE MEDIUM.

Yu.V.Goryunov, N.V.Pertsov, E.D.Shchukin and P.A.Rebinder.

Dokl. Akad. Nauk SSSR, Vol. 128, No. 2, 269-72 (Sept. 11, 1959). In Russian.

The authors investigated the effect of a thin layer of liquid gallium on the properties of tin single crystals. The stress needed to produce fracture dropped sharply as a function of the time of adsorption and the crystals also became much more brittle. X-ray photographs taken after various adsorption times showed that the single crystals were broken up, and this tendency was confirmed by electrical resistance measurements. M.G.Priestley

539.4

6314 ON THE MECHANISM OF FRACTURE OF SOLID BODIES. S.N.Zhurkov and A.V.Savitskii.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 1, 91-3 (Nov. 1, 1959). In Russian.

The authors consider a possible bearing of the diffusion theory of crack formation in metals on the time-temperature dependence of breaking under tensile stresses. The specimen used was polycrystalline silver. They find no correlation between the coefficient of diffusion and the time constant of breaking, as suggested by that theory and conclude that the rate of growth of cracks does not depend on the diffusion mobility of atoms in metals.

J.K.Skwirzynski

539.4

6315 CRACKS IN TRANSPARENT PLASTICS, THEIR GROWTH AND STRUCTURE.

M.I.Bessonov and E.V.Kuvshinskii.

Fiz. tverdogo Tela, Vol. 1, No. 9, 1440-7 (Sept., 1959). In Russian.

Describes an interference method of investigating cracks on transparent materials which provides some data on their growth and structure. Observations have been made in specimens of rectangular and circular cross-section cut from polystyrene and polymethylmethacrylate with 2% plasticizer (dibutylphthalate). Under a tensile stress of a few kg/mm^2 the specimens develop surface cracks, which are seen, under the microscope, to run normal to the direction of the applied stress. Viewed along the stress axis under parallel illumination, interference fringes are seen in the air wedges formed by the cracks. The thread-like structure of the cracks can be related to the nature of the polymerized structure. 15 plates. W.Bardsley

539.4

6316 THE VALIDITY OF THE BRITTLE FRACTURE OF SINGLE CRYSTALS OF ZINC.

L.S.Bryukhanova, L.A.Kochanova and V.I.Likhtman.
Fiz. tverdogo. Tela, Vol. 1, No. 9, 1448-56 (Sept., 1959). In Russian.

Recently is has become necessary in studying the mechanical properties of metals, their strength and plasticity, to take account of the physical–chemical reaction of the surrounding medium. In recent work the authors noticed the influence of molten metals on the mechanical properties of refractory metals in lowering their strength and plasticity. The effect of a thin film of liquid Sn on Zn is to produce reversible changes in the mechanical properties of the Zn, and Hg is also strongly surface active in this respect. Brittle fracture is studied in single-crystal Zn with different starting orientations of the basal plane relative to the wire axis ($13^0 \leq \chi_0 \leq 80^0$) at liquid nitrogen temperatures (–196°C) with constant velocity of extension (~1% min^{-1}). The metal is 99.99% pure prepared by zone refining and gives a critical shear stress on the basal plane of 130 g. mm^{-2} at –196°C. The limiting value of the plastic extension, the normal fracture and shear stresses are given as a function of χ_0, results being shown in tabular and graphical form. On amalgamating with Hg these values change and measurements taken at both –196°C and 20°C are compared with those on the pure Zn crystals. W.Bardsley

539.4

6317 EFFECT OF THE SURFACE CONDITION (FINISH) ON COLD BRITTLENESS. N.N.Davidenkov and I.S.Efimova.
Fiz. tverdogo Tela, Vol. 1, No. 10, 1516-20 (Oct., 1959). In Russian.

Properties of cylindrical Mo test-pieces with two different surface finishes (machined on a lathe, and carefully polished) were measured to elucidate the effect under consideration. The critical temperature of cold brittleness was found to be for the latter test-pieces lower (by about 35°C) than for the former ones. The "brittle" strength (at the boiling point of N_2) was, for the former test-pieces, higher by about 24% than that for the latter. F.Lachman

539.4

6318 DETERMINATION OF THE FORM OF SUBMICROSCOPIC CRACKS IN DEFORMED POLYMERS.

S.N.Zhurkov, A.I.Slutsker and V.A.Marikhin.
Fiz. tverdogo Tela, Vol. 1, No. 11, 1752-4 (Nov., 1959). In Russian.

A formula is given for the light-scattering indicatrix of an assemblage of particles. The indicatrix of an organic glass under tension is measured with the incident light parallel and perpendicular to the applied stress. The results indicate that the submicroscopic cracks are lens-shaped, with principal dimensions about 100 A and 600 A respectively parallel and perpendicular to the applied stress. R.F.S.Hearmon

539.4 : 541.13

6319 FLOW OF ELECTROLYTE WITHIN A PROPAGATING STRESS-CORROSION CRACK. J.M.West.
Nature (London), Vol. 185, 92-3 (Jan. 9, 1960).

Previous work had led to the inference that the advancing edge of a propagating stress-corrosion crack dissolved continuously into substantially virgin electrolyte, in view of the concomitant yawning. This hypothesis is now tested by two models, viz., where a curved surface bends away from a plane one, so that there is progressive yawning of the crack (i.e. resembling a true stress-corroding crack); and when two straight surfaces are slid over each other. It is concluded that for thin long propagating cracks, anodic dissolution occurs into electrolyte contaminated no more than five times by the previous crack contents, so long as the electrolyte thoroughly wets the sides of the crack. H.H.Hodgson

539.4

6320 A MODEL OF METAL FATIGUE. A.N.May.
Nature (London), Vol. 185, 303-4 (Jan. 30, 1960).

A mathematical expression for the number of valleys, of a certain width within a range of depths, formed on the surface of a fatigued specimen, as a function of the number of cycles and the Burgers slip vector, is given, which is based on a model which assumes that a random distribution of slip occurs at each half cycle. The number of cycles required to produce the first incipient crack is calculated and found to be in satisfactory agreement with observed lifetimes. R.Bullough

539.5

6321 THE THEORY OF AN IDEALLY HARDENING MEDIUM. D.D.Ivlev.
Dokl. Akad. Nauk SSSR, Vol. 130, No. 4, 742-5 (Feb. 1, 1960). In Russian.

As a mathematical model of material with work hardening, it is assumed that there is no stress at small strains and stress increases discontinuously if strain increases beyond a critical limit. Equations derived in accordance with these propositions determine the general mutual dependence of all components of stress and strain in an isotropic medium. R.Eisenschitz

539.6

6322 PICK-UP OF COPPER AND DURALUMIN ON BONDED TUNGSTEN CARBIDE. J.Golden and G.W.Rowe.
Brit. J. appl. Phys., Vol. 10, No. 8, 367-71 (Aug., 1959).

Experiments have been made using radioactive copper and duralumin to study their pick-up on cobalt-bonded tungsten carbide. Both copper and duralumin adhere to the carbide surface, forming a thin layer or "shoe" of transferred metal, the amount of which increases during the first few millimetres of contact and then reaches a constant value. The eventual size of the copper shoe, and the distance required to pick it up, both increase with the roughness of the carbide surface. Once the shoe has been acquired, a dynamic equilibrium is established between it and the track, with copper transferring steadily to and from the shoe on the carbide. Duralumin also shows a rapid initial pick-up, but the shoe subsequently remains static and does not steadily exchange. Fragments do, however, break off occasionally as sliding proceeds. Auto-radiographs show that the transfer of tungsten carbide to copper occurs smoothly while the transfer of carbide to duralumin is erratic. It is suggested that the pick-up and wear processes are closely associated.

539.6

6323 ON THE CRITERIA OF WEAR OF MATERIALS. I.V.Kragel'skii.
Dokl. Akad. Nauk SSSR, Vol. 129, No. 5, 1016-19 (Dec. 11, 1959). In Russian.

The energy criterion of wear is defined as

$$I(W) = V/W \text{ cm}^3 \text{ kg}^{-1}$$

where V is the volume of the part worn off, and W is the work of friction. Two other criteria (the specific one and the weight one) are defined, and these are related to the energy criterion. The specific criterion of metals is almost constant with respect to the hardness of specimens and depends mainly on their shape. J.K.Skwirzynski

CRYSTALLOGRAPHY
CRYSTAL STRUCTURES

539.2 : 548

6324 FORMATION OF AN AMORPHOUS FORM OF QUARTZ UNDER SHOCK CONDITIONS.

P.S.de Carli and J.C.Jamieson.
J. chem. Phys., Vol. 31, No. 6, 1675-6 (Dec., 1959).

Natural quartz crystals were struck by explosively driven aluminium plates to produce pressures of 600 kilobars (calculated). Possible mechanisms of formation of amorphous quartz are discussed. A.R.Stokes

539.2 : 548.5

6325 CONTROLLING THE HABIT OF POTASSIUM COBALTICYANIDE CRYSTALS.

A.E.Rennie and S.Nielsen.

Brit. J. appl. Phys., Vol. 10, No. 9, 429 (Sept., 1959).

Traces of impurity can affect the habit considerably. Good crystals for maser use are obtained from a solution with 0.1% K_2SO_4 added. A.R.Stokes

539.2 : 548.5

6326 LIQUID–SOLID INTERFACE SHAPE OBSERVED IN SILICON CRYSTALS GROWN BY THE CZOCHRALSKI METHOD. W.D.Edwards.

Canad. J. Phys., Vol. 38, No. 3, 439-43 (March, 1960).

A study has been made of the macroscopic structure of the liquid–solid interface which exists during growth of silicon crystals by the Czochralski method. In two crystals the interface was seen to contain a (111) facet. The development of such facets is discussed with reference to current crystal growth theories.

539.2 : 548.5 : 538.2

6327 PREPARATION OF FERRITE SINGLE CRYSTALS BY THE VERNEUIL PROCESS. G.Elbinger.

Exper. Tech. der Phys., Vol. 7, No. 5, 193-208 (1959). In German.

Describes in detail the method of preparation and the investigation of the resultant materials. Measurements of crystal magnetic anisotropy constant, spontaneous magnetization, density, and lattice parameter, were made and compared with values for single crystals grown by other methods, such as that due to Bridgman and Stockbarger. C.A.Hogarth

539.2 : 548.5

6328 TORSION INDUCED RECRYSTALLIZATION OF MOLYBDENUM AND TUNGSTEN FILAMENTS.

F.E.Gifford and E.A.Coomes.

J. appl. Phys., Vol. 31, No. 2, 235-7 (Feb., 1960).

When an optimum amount of permanent twist is introduced in 3 to 10 mil filaments of molybdenum or tungsten, single crystals up to 15 cm in length grow by either the moving gradient or Robinson techniques. About 5 turns per inch for W at 2500°K or for Mo at 1650°K were favourable. Although there is evidence of perfection in the volume of the crystals, the twist leaves a threadlike surface imperfection which remains even after severe heat treatment at evaporation temperatures.

539.2 : 548.5

6329 PURIFICATION OF ORGANIC MATERIALS BY ZONE REFINING. J.H.Beynon and R.A.Saunders.

Brit. J. appl. Phys., Vol. 11, No. 3, 128-31 (March, 1960).

Three zone refiners are described which between them are suitable for dealing with materials having melting points in the range −10 to +300°C in quantities of from 0.5 to 9000 g. Some of the more interesting results are discussed in detail, and a list of compounds which have proved amenable to this method of purification is given.

539.2 : 548.5

6330 UNIFORM RESISTIVITY P-TYPE SILICON BY ZONE LEVELING. E.D.Kolb and M.Tanenbaum.

J. Electrochem. Soc., Vol. 106, No. 7, 597-9 (July, 1959).

Silicon single crystals nominally 1 cm in diameter and 16 cm long have been grown with aluminium doping in a floating zone apparatus. Crystals have been prepared with nominal p-type resistivities of 0.3 and 5 ohm cm with variations of 5% or less along the crystal length. Variations of resistivity with rotation rate, growth rate, ambient gas flow rate, and other growth variables have been studied. Zone volume variations were also measured.

548.5 : 77

FORMATION AND GROWTH OF SILVER NUCLEI IN SILVER HALIDE MICRO-CRYSTALS. See Abstr. 3663

539.2 : 548.5 : 538.27

GROWTH OF SINGLE CRYSTAL TUNGSTATES FOR RESONANCE AND EMISSION STUDIES. See Abstr. 6265

539.2 : 548.5

6331 NEEDLE GROWTH IN THE OXIDATION OF COPPER. I. L.Albert and W.Jaenicke.

Z. Naturforsch., Vol. 14a, No. 12, 1040-6 (Dec., 1959). In German.

The oxide surface, formed at 300°C and at 500°C on electrolytic copper foil, was examined in the electron microscope, the specimen preparation being carried out according to the method of Bradley (Abstr. 3909, 5031 of 1954). The fraction of needles having length between λ and $\lambda + d\lambda$ was found to be given by

$$\frac{dN}{N} = ke^{-k\lambda}d\lambda.$$

Speed of needle growth appears to be controlled by surface diffusion. W.Good

539.2 : 548.5

6332 MOLYBDENUM OXIDE FILAMENT FORMATION. T.Lewowski and B.Sujak.

Z. Naturforsch., Vol. 15a, No. 1, 89-90 (Jan., 1960). In German.

Molybdenum oxide filaments formed on Mo wire heated in air to 500°C in an electric field. No filament formation occurred in the absence of a field, but the field was required only during the initial growth stage. Reversal of polarity destroyed the filaments. The filaments were polycrystalline. J.Franks

539.2 : 548.5

6333 GROWTH, STRUCTURE, AND PROPERTIES OF GRAPHITE WHISKERS. R.Bacon.

J. appl. Phys., Vol. 31, No. 2, 283-90 (Feb., 1960).

Graphite whiskers have been grown in a d.c. arc under a pressure of 92 atm of argon and at 3900°K. They are embedded in a solid matrix of graphite which builds up by diffusion of carbon vapour from the positive to the negative electrode. Diameters range from a fraction of a micron to over five microns, with recoverable lengths up to 3 cm. They consist of one or more concentric tubes, each tube being in the form of a scroll, or rolled-up sheet of graphite layers, extending continuously along the length of the whisker, with the c axis exactly perpendicular to the whisker axis. They exhibit a high degree of flexibility, tensile strengths up to 2000 kg mm^{-2}, Young's modulus in excess of 7×10^{12} dyne cm^{-2}, and values of room-temperature resistivity of around 65 μohm cm, which approximates the single crystal value.

539.2 : 548.5

6334 WHISKER GROWTH FROM A DOUBLE SPIRAL SOURCE. H.Weik and E.B.Henschke.

Naturwissenschaften, Vol. 47, No. 1, 12-13 (1960). In German.

Support for such a mechanism is obtained from electron-micrographs of etched cross-sections of iron whiskers. J.E.Caffyn

539.2 : 548.5

6335 THE EPITAXIAL GROWTH OF ICE ON SINGLE-CRYSTALLINE SUBSTRATES.

G.W.Bryant, J.Hallett and B.J.Mason.

J. Phys. Chem. Solids, Vol. 12, No. 2, 189-95 (Jan., 1960).

Epitaxial deposits of ice crystals have been formed on the basal (0001) faces of hexagonal AgI, PbI_2, CuS, CdI_2 and brucite, on the (001) face of freshly-cleaved muscovite, on the (010) face of orthorhombic HgI_2, on the (001) face of orthorhombic iodine, on the (100) face of V_2O_5 and on the rhombohedral faces of calcite. The temperature at which ice crystals first appear on a particular substance is very close to the threshold temperatures at which an aerosol of the same substance nucleates a cloud of supercooled water droplets. The crystals appear preferentially at cleavage and growth steps on the substrate surface, provided that these exceed ~ 0.1 μ in height and preserve their parallel orientation irrespective of the direction of the step. Thin, hexagonal ice plates, growing on the basal plane of covellite (CuS), show interference colours which give a measure of their thickness. Commonly, the ice crystals increase appreciably in diameter with no discernible change of thickness, suggesting that molecules arriving on the upper surface are not assimilated but migrate over the surface and are built at at the crystal edges. Crystals usually thicken on touching a neighbouring crystal; coloured growth fronts are then seen spreading out across the crystal surface from the point of contact. Detailed measurements on AgI, PbI_2, CuS and CdI_2 show that, for a given substance, there is a well-defined critical temperature above which ice crystals can appear only if the air exceeds saturation relative to liquid water, but below which ice forms directly from the vapour phase provided that the supersaturation relative to ice exceeds 12 per cent for silver iodide and slightly different values for the other substrates. These critical supersaturations are required for growth at the edges of steps; ice appears on the flat parts of the substrate only at much higher supersaturations (>100 per cent).

539.2 : 548.5

6336 TOPOTACTICALLY CRYSTAL-ORIENTED FERROMAGNETICS. F.K.Lotgering.
Philips tech. Rev., Vol. 20, No. 12, 354-6 (1958-59).

Describes a new method of crystal orientation in ceramic ferromagnetics. The method is based on the phenomenon that in a chemical reaction between solids the crystal orientation of the reaction product is sometimes correlated with that of one of the initial substances ("topotaxy"). Topotactical orientation is observed in the group of materials known as ferroxdure and ferroxplana and forms an elegant method for preparing well-oriented compounds of this kind of various compositions.

539.2 : 548.5

6337 ON TOPOTAXY. J.D.Bernal and W.Feitknecht.
Schweiz. Arch. angew. Wiss. Tech., Vol. 26, No. 2, 69-75 (Feb., 1960).

"Topotaxy" is the transformation of one crystal into another of different composition without any large alteration of axial direction. A number of illustrative examples of this phenomenon are described, drawn mostly from the systems of hydrated calcium silicate hydrates and iron oxide and hydroxide phases. It is maintained that "topotaxy" is very widespread and may be the commonest method of transformation in solid-state reactions.

539.2 : 548.5

6338 DEVELOPMENT OF FACETS, SPIRALS, AND ETCH PITS ON COPPER CRYSTALS BY HEATING TO HIGH TEMPERATURES IN HIGH VACUA.
F.W.Young, Jr and A.T.Gwathmey.
J. appl. Phys., Vol. 31, No. 2, 225-30 (Feb., 1960).

Single crystal spheres of O.F.H.C. and 99.999% copper were heated to temperatures of 950° to 1075° in high vacua. In the case of the O.F.H.C. copper, facets parallel to the (111), (110), and (100) planes were formed over relatively large areas centred at the respective poles, and with some of these crystals spiral facets were formed around the (111) pole. When an O.F.H.C. crystal was heated in a copper cup, an appreciable number of pits were formed. In the case of the 99.999% copper, facets parallel to the (111) and (100) planes were formed in small areas around the respective poles, and at certain temperatures etch pits were formed. An attempt was made to interpret the difference in the size of the facets formed on the two types of crystals in terms of the influence of impurities on the rates of evaporation. It was proposed that the etch pits formed at dislocations in the crystal, although there was not a one-to-one correspondence between pits and dislocations.

539.2 : 548.5

6339 EFFECT OF THE POLARITY OF THE III–V INTERMETALLIC COMPOUNDS ON ETCHING.
J.W.Faust, Jr. and A.Sagar.
J. appl. Phys., Vol. 31, No. 2, 331-3 (Feb., 1960).

For the III–V intermetallic compounds, the ⟨111⟩ directions are polar axes. The shape of etch pits bounded by crystallographic planes and the presence or absence of pits at dislocations are influenced by the effect of the polar axes on the etch rates. Studies of these effects are reported for several etches on InSb, InAs, GaSb, and GaAs. Correlation of these studies with published X-ray investigations shows that these etches reveal dislocations and truncated pyramidal pits only on {111} surfaces that are at the group III end of the polar axis. A difference in the shape of the pits on opposite {100} surfaces was found and is explained by means of the polar axes.

539.2 : 548.5

6340 ON THE JET ETCHING OF N-TYPE Si.
P.F.Schmidt and D.A.Keiper.
J. Electrochem. Soc., Vol. 106, No. 7, 592-6 (July, 1959).

The rate of jet electropolishing of low resistivity n-Si is controlled by two factors: supply of injected minority carriers and rate of dissolution of the SiO_2 film. The current through the oxide changes from ionic to electronic, i.e. the silicon becomes passive, if the oxide thickness increases beyond a critical value. The hole supply determines the amount of etching which can occur when the Si is not passivated by a thick oxide layer.

539.2 : 548.5

6341 METHOD FOR THE DETECTION OF FLAWS IN YTTRIUM IRON GARNET CRYSTALS.
E.Buehler and M.Tanenbaum.
J. appl. Phys., Vol. 31, No. 2, 388-90 (Feb., 1960).

Infrared techniques similar to those used in examining silicon crystals were applied to the examination of yttrium iron garnet crystals. Photographic results for both flux grown and sintered crystals are given.

539.2 : 548.5

6342 A NEW TYPE OF CRYSTALLINE STRUCTURE IN GUTTA-PERCHA. G.E.Novikova and O.N.Trapeznikova.
Fiz. tverdogo Tela, Vol. 1, No. 12, 1789-90 (Dec., 1959). In Russian.

Observations were made of the crystallization process in thin films of gutta-percha cooled slowly near the melting point between cover glasses under crossed nicols in a polarization microscope. Crystallites of ellipsoidal shape were found, and from their optical behaviour with regard to polarized light, it was inferred that the molecular orientation was perpendicular to the major axis of the ellipse. R.F.S.Hearmon

539.2 : 548.5

6343 ANNEALING OF SILVER CHLORIDE CRYSTALS CONTAINING INTERNAL PRINT-OUT.
C.Childs and L.Slifkin.
J. Phys. Chem. Solids, Vol. 12, No. 2, 119-21 (Jan., 1960).

The Haynes–Shockley technique was used to obtain internal print-out in single silver chloride crystals. Print-out was produced in all crystals from various boules after observing that, in some disks from the boules, the surface deformation from manufacturer disk-shaping had a depth of 2.54 mm. After internal print-out was produced, the crystals were given a short MgO anneal at 425°C, which decorated substructure and produced small internal precipitates with definite geometric configurations. Annealing at 425°C for 40-50 hr produced uniform cylindrical precipitates with diameters of approximately 2 μ and lengths < 0.7 mm. An investigation of these elongated precipitates showed that they were in the six [110] crystallographic directions. The growth process of these precipitates are shown and discussed.

539.2 : 548.7

6344 AN ELECTRON DIFFRACTION CAMERA OF SIMPLIFIED DESIGN. S.N.Chatterjee.
Indian. J. Phys., Vol. 32, No. 8, 369-72 (Aug., 1958).

This is designed so that the majority of the specimen motions required for all types of diffraction work can be transmitted into vacuum through a Wilson seal using a rubber gasket only. Diffraction photographs can be taken from four specimens without disturbing the vacuum and with an accuracy better than 1%. The camera has been adapted for use with an electron microscope after the projector lens stage, and can be adjusted to have a shadow micrograph of the specimen under examination.

539.2 : 548.7

6345 NEW METHOD FOR THE DETERMINATION OF GRAIN OR CRYSTALLITE SIZE FROM SPOTTY DIFFRACTION RINGS. K.W.Andrews and W.Johnson.
Brit. J. appl. Phys., Vol. 10, No. 7, 321-5 (July; 1959).

The method uses transmission photographs. The specimen is also oscillated through a known angle. Possible confusion between Laue and Debye-Scherrer spots is therefore avoided, and adjustment of experimental conditions to give a suitable number of spots enables a wide range of grain sizes to be covered. The angular divergence of the X-ray beam can be eliminated and the volume of specimen irradiated accurately estimated. The effects of grain-size distribution on visibility and blackening of spots are considered and a graphical method is proposed which takes account of grains at the surface and within a specimen.

539.2 : 548.7

6346 SIMPLE METHOD OF DETERMINING CRYSTAL PERFECTION. H.K.Herglotz.
J. Electrochem. Soc., Vol. 106, No. 7, 600-5 (July, 1959).

An optical analogy leads to a simple X-ray method of determining crystal perfection. Although furnishing only semiquantitative information at present, this can be developed into a quantitative method. For some applications it is considered superior to existing techniques such as etch pit counts or X-ray rocking curves. This method is combined with the determination of the crystal orientation since it is based on a slightly modified Laue back reflection method.

539.2 : 548.7

6347 TECHNIQUE FOR DETERMINING THE ORIENTATION OF SINGLE CRYSTALS OF BISMUTH.
D.T.J.Hurle and S.Weintroub.
Brit. J. appl. Phys., Vol. 10, No. 7, 336-9 (July, 1959).

Except in particular cases, neither X-rays nor light figures alone suffice to determine completely and unambiguously the orientation of a bismuth crystal rod. The technique described consists of a combination of the two. The light figure pattern is used to locate the (111) plane approximately in order to align the rod relative to the X-ray beam before the back-reflection Laue photograph is taken, and to assist in the interpretation of the stereographic projection. The modifications made to a Unicam single-crystal X-ray goniometer to enable the technique to be applied to rods of 6 mm diameter and 25 cm length are described.

539.2 : 548.7

6348 A SIMPLE AND ACCURATE TECHNIQUE FOR THE CORRECTION OF X-RAY INTENSITIES FOR ANGLE FACTORS IN THE EQUI-INCLINATION METHOD. T.Löfgren.
Acta cryst., Vol. 13, Pt 2, 156-9 (Feb., 1960).

An improved method for converting Weissenberg intensities to a relative $|F|^2$ scale is presented together with the relevant table of factors. The method is based on a simple change of variable and increases the accuracy.

539.2 : 548.7

6349 INFLUENCE OF INSTRUMENTAL ABERRATIONS ON THE SCHULTZ TECHNIQUE FOR THE MEASUREMENT OF POLE FIGURES. B.Gale and D.Griffiths.
Brit. J. appl. Phys., Vol. 11, No. 3, 96-102 (March, 1960).

An experimental and theoretical investigation of the Schulz reflection technique for measuring pole figures has shown that it is capable of giving accurate results provided the integrated intensities are measured. A detailed discussion is given of the influence of the aberrations of the optical system on the diffraction-line shapes from which it is concluded that the integrated intensities are unaffected by tilting the specimen and that, for large tilts, the vertical height of the beam is limited only by its overlap of the specimen or by lack of resolution of neighbouring diffraction lines.

539.2 : 548.7

6350 THE DETERMINATION OF SPECIFIC SURFACES AND INTERFACES BY SMALL ANGLE SCATTERING OF X-RAYS. I. THEORETICAL PRINCIPLES. J.L.Soulé.
J. Phys. Radium, Vol. 18, Suppl. No. 7, 90A-102A (July, 1957). In French.

Starting from the general theory, deriving systematically different equivalent expressions for the fundamental equation, an immediate application makes it possible to take into account the law of distribution of the intensity in the primary beam to obtain the properties of the principal typical parameters of any diagram to consider the effect of multiple scattering. The characteristic features of the diagrams relative to structures with a defined interface are investigated and related to the asymptotical behaviour of the scattering law at large angles (in the case of simple or multiple scattering) to one "specific discontinuity" of the sample (specific interface multiplied by the mean square of the change of density at the points of discontinuity). Finally some equations are presented concerning dilute and dense systems of particles, which enable one to relate the typical parameters to "mean diameters".

539.2 : 548.7

6351 FIELDS OF X-RAY WAVES IN CRYSTALS. M. von Laue.
S. B. Dtsch. Akad. Wiss. Berlin, Kl. Math. Phys. Tech., 1959, No. 1, 3-26. In German.

A review of recent work, at the Fritz Haber Institute of the Max Planck Gesellschaft, on flow of energy through a crystal in the reflecting position and on the X-ray photography of dislocation lines. A.R.Stokes

539.2 : 548.7

6352 A REPLY TO SOME COMMENTS BY KARLE AND HAUPTMAN. A.Klug.
Acta cryst., Vol. 12, Pt 11, 943 (Nov., 1959).

See Abstr. 10364 (1959). The author questions the claim of Karle and Hauptman to have obtained (see Abstr. 891 of 1957) "measures of statistical significance based on the appropriate variances of individual terms in phase-determining formulae", as given by the author in a later paper (Abstr. 7645 of 1959). A.R.Stokes

539.2 : 548.7

6353 THE CUMULATIVE DISTRIBUTION OF STRUCTURE AMPLITUDES. G.A.Sim.
Acta cryst., Vol. 13, Pt 1, 58-9 (Jan., 1960).

It is shown that a cumulative distribution function based on structure amplitudes rather than on intensities may be used as an alternative test for differentiating between centrosymmetric and non-centrosymmetric structures when a unit cell contains a heavy atom or atoms. J.Adam

539.2 : 548.7 : 518.5

MECHANICAL STRUCTURE-FACTOR COMPUTER. See Abstr. 4842

539.2 : 548.7

6354 SEPARATION OF EFFECTS DUE TO LATTICE DISTORTION AND DISPERSION (PARTICLE SIZE) IN POLYCRYSTALLINE MATERIALS IN THE HARMONIC ANALYSIS OF A SINGLE X-RAY DIFFRACTION LINE. B.I.Smirnov.
Fiz. tverdogo Tela, Vol. 1, No. 7, 1072-5 (July, 1959). In Russian.

A diffraction line from a nickel sample deformed in tension was Fourier analysed using various ranges and numbers of intervals. The estimate of particle size obtained by "the tangent method" depends very strongly on the range and the number of intervals used in analysis while the strain estimate is not very sensitive to the selected conditions of analysis. J.Adam

539.2 : 548.7

6355 SOUNDNESS OF THE LATTICE OF ZONE-REFINED ALUMINIUM. M.E.Straumanis and T.Ejima.
J. chem. Phys., Vol. 32, No. 2, 629-30 (Feb., 1960).

The difference between actual density and X-ray density is used to estimate the number of defects per unit cell for recrystallized zone-refined Al. It is concluded that the lattice is "sound". J.Thewlis

539.2 : 548.7

6356 ALUMINUM BORIDE, AlB_{12}.
J.A.Kohn and D.W.Eckart.
Analyt. Chem. Vol. 32, No. 2, 296-8 (Feb., 1960).

Crystals of α-AlB_{12} and β-AlB_{12} were prepared by two methods, either from the simple melt reaction with the two elements or from an aluminothermic reaction using elemental aluminium and B_2O_3. The details of preparation have been given by Kohn, Katz and Giardini [Zeitschrift für Kristallographie, Vol. 111, 53-62 (1958)]. The crystal morphology, X-ray diffraction data, optical properties and fusion behaviour were determined for both the α and β phases, and are described in detail. R.Bullough

539.2 : 548.7

6357 B2-PHASES OF ALUMINIUM WITH TRANSITION METALS OF GROUPS VII AND VIII OF THE PERIODIC TABLE. W.Obrowsky.
Naturwissenschaften, Vol. 47, No. 1, 14 (1960). In German.

The existence of the phases ReAl, RuAl, OsAl was demonstrated. They crystallize with the CsCl structure, the lattice constants being respectively 2.88, 3.03 and 3.005 A. L.Pincherle

539.2 : 548.7 : 538.2

NEUTRON DIFFRACTION STUDY OF ANTIFERROMAGNETIC CrN. See Abstr. 6248

539.2 : 548.7

6358 ON THE RELATIONSHIP BETWEEN THE β-W AND GARNET STRUCTURES. S.Geller.
Acta cryst., Vol. 12, Pt 11, 944-5 (Nov., 1959).

The β-W structure (e.g. Nb_3Sn) is like the garnet structure with the oxygen atoms removed. Ferrimagnetic and superconducting properties of these structures are discussed. A.R.Stokes

539.2 : 548.7 : 538.2

6359 CRYSTAL CHEMICAL AND MAGNETIC STUDIES OF GARNET SYSTEMS $M_3^{2+}Fe_2Sn_3O_{12}$–$Y_3Fe_5O_{12}$
S.Geller, R.M.Bozorth, M.A.Gilleo and C.E.Miller.
J. Phys. Chem. Solids, Vol. 12, No. 2, 111-18 (Jan., 1960).

A complete solid-solution range exists in the system $Ca_3Fe_2Sn_3O_{12}$(CIS)–$Y_3Fe_5O_{12}$(YIG). Because of its large size, the Sn^{4+} ion prefers the octahedral positions; thus for dilute solutions of CIS in YIG the saturation magnetization at 0° K increases. A maximum of 7.3 μ_B per formula unit is reached at about 20 mol.

per cent CIS solid solution. However, the plot of $n_B(=,0)$ against composition deviates markedly from that which depends only on a simple interaction model. At 33 mol. per cent CIS, $n_B = 5.2\ \mu_B$, and at 50 mol. per cent, $n_B = 1.2\ \mu_B$, even though the Sn^{4+} ions are very nearly all in the octahedral sites. At 67 mol. per cent CIS, 90 per cent of the octahedral sites are filled with Sn^{4+} ions, as determined by X-ray diffraction, and $n_B \approx 0.25\ \mu_B$. The magnetic behaviour of this system may be explained on the basis of the reduction of the number of octahedral-tetrahedral magnetic-ion interactions with increasing concentration of CIS and, at the higher concentrations, the establishment of two magnetic sublattices among the tetrahedral ions. No other end-members $M_3^{2+}Fe_2Sn_3O_{12}$ were obtained, but with M = Sr the extent of solubility in YIG is ~ 33 mol. per cent, and when M = Ba, <5 mol. per cent. Some inconclusive experiments also indicated some solution when M = Cd, Zn, Mn, Ni and Mg.

539.2 : 548.7

6360 ON THE STRUCTURAL RELATIONSHIP OF VITREOUS POTASSIUM PENTABORATE TO THE CRYSTALLINE MODIFICATIONS. J.Krogh-Moe.

Ark. Kemi, Vol. 14, Paper 52, 567-72 (1959).

The density and unit cell of α-potassium pentaborate were measured. The density of the α-modification is lower than that of the glass of the same chemical composition, whereas the density of the β-modification is higher. The radial distribution curve for rubidium pentaborate glass was determined and is discussed. The infrared absorption spectra of 4 different potassium borate phases were recorded. Some similarities of glass and crystalline phases were noted.

539.2 : 548.7

6361 NEUTRON DIFFRACTION STUDY ON SODIUM TUNGSTEN BRONZES Na_xWO_3 ($x = 0.9 \sim 0.6$).

M.Atoji and R.E.Rundle.

J. chem. Phys., Vol. 32, No. 2, 627-8 (Feb., 1960).

Cubic, space group Im3m; the unit cell contains eight Na_xWO_3 and $a = 2a'$, where a' is the X-ray lattice constant. Reflections not detectable in the X-ray pattern were observed and a distorted perovskite structure is proposed. Apparent conflict of this structure with the optical behaviour of the crystals is discussed in terms of twinned domains. Data obtained at $-100^\circ C$, at which the structure is untwinned, showed the same symmetry as at room temperature but oxygen positions are probably slightly altered. J.Adam

539.2 : 548.7

6362 ACCURACY IN STRUCTURE ANALYSIS OF LAYER SILICATES.

A.McL.Mathieson, E.W.Radoslovich and G.F.Walker.

Acta cryst., Vol. 12, Pt 11, 937-8 (Nov., 1959).

Criticizes the claims made in recently published analyses that small departures from the high symmetry of "ideal" structures of layer silicates have been demonstrated. It appears that some of these refined structures are based on diffraction data insufficient to warrant the claimed minor details, however plausible they may be. Work by Steinfink [Acta cryst., Vol. 11, Pt 3, 191 (March, 1958)] on chlorite is considered in detail as an example. J.Adam

539.2 : 548.7

6363 STUDY OF RHOMBOHEDRAL V_2O_3 BY NEUTRON DIFFRACTION. A.Paoletti and S.J.Pickart.

J. chem. Phys., Vol. 32, No. 1, 308-9 (Jan., 1960).

The investigation was undertaken in order to obtain information about the changes in the properties of V_2O_3 between 168° and 533°K, which it had been suggested were due to the presence of antiferromagnetism at the lower temperature. The neutron diffraction results did not support this suggestion, but the changes in the diffraction pattern can be accounted for by a structural transition, for which prior evidence has been obtained by low-temperature X-ray diffraction. J.Thewlis

539.2 : 548.7

6364 SPACE GROUP AND CELL DIMENSIONS OF A SPECIMEN OF HOLLANDITE. B.Mukherjee.

Acta cryst., Vol. 13, Pt 2, 164-5 (Feb., 1960).

539.2 : 548.7 : 535

OPTICS AND STRUCTURE OF WHEWELLITE. See Abstr. 6169

539.2 : 548.7

6365 CRYSTAL STRUCTURE OF TRIMETHYLAMINOXYD HYDROCHLORIDE. C.Rérat.

Acta cryst., Vol. 13, Pt 2, 63-71 (Feb., 1960). In French.

The crystals of trimethylaminoxyd hydrochloride, $(CH_3)_3NO,HCl$, belong to space group Pnam. The cell has the dimensions: $a = 14.27 \pm 0.05$, $b = 5.40 \pm 0.05$, $c = 7.61 \pm 0.05$ A. It contains four molecular units. The structure was obtained from electron-density projections along the c and b axes. The atomic co-ordinates were refined by least squares applied to the 676 reflections observed with Cu Kα radiation. The chlorine, oxygen, and nitrogen atoms and one carbon atom (C_1) are on the mirror plane. Two carbon atoms (C_2 and C_2') occupy one general position. The N–O bond is 1.42 A long.

539.2 : 548.7

6366 CRYSTAL STRUCTURE OF PIPERIDINE HYDROCHLORIDE. C.Rérat.

Acta cryst., Vol. 13, Pt 2, 72-80 (Feb., 1960). In French.

Piperidine hydrochloride, $C_5H_{11}N$, HCl, gives needle-shaped crystals belonging to space group Pcmb. The cell has the dimensions $a = 9.84 \pm 0.05$, $b = 9.86 \pm 0.05$, $c = 7.4 \pm 0.1$ A, and contains four molecular units. The structure was obtained from electron-density projections along the c and b axes. The refinement was conducted by least squares applied to the 681 reflections observed with Cu Kα radiation. The chlorine and nitrogen atoms, and one carbon atom (C_3) are on the mirror plane. Four carbon atoms (C_1, C_1', C_2, C_2') occupy two general positions. The piperidine molecule has the "chair form" structure.

539.2 : 548.7

6367 THE CRYSTAL STRUCTURE OF BIS-ETHYLENE THIOUREA-CADMIUM THIOCYANATE.

L.Cavalca, M.Nardelli and G.Fava.

Acta cryst., Vol. 13, Pt 2, 125-30 (Feb., 1960).

The crystals are monoclinic and are isostructural with the corresponding lead compound. The cell dimensions are: $a = 15.60 \pm 0.04$, $b = 8.17 \pm 0.02$, $c = 11.51 \pm 0.01$ A; $\beta = 95° 41'$; the number of formula units per unit cell is 4 and the space group is C_{2h}^6–C 2/c. The structure was solved by two dimensional Patterson and Fourier syntheses, and refinement was carried out with generalized projections of partial differences and back-shift corrections. The cadmium atom coordinates octahedrally with two sulphur atoms attached to ethylenethiourea molecules, and with two sulphur and two nitrogen atoms in four different NCS groups. The coordination polyhedra are therefore linked in chains by these NCS groups, which form bridges between cadmium atoms.

539.2 : 548.7

6368 A PRELIMINARY CRYSTALLOGRAPHIC INVESTIGATION OF 1-PHENYLHYDANTOIN AND THREE DERIVATIVES OF URACIL. R.Gerdil.

Acta cryst., Vol. 13, Pt 2, 165-6 (Feb., 1960).

539.2 : 548.7

6369 ON THE ARRANGEMENT OF THE WATER MOLECULES IN THE CRYSTAL STRUCTURE OF CAFFEINE.

R.Gerdil and R.E.Marsh.

Acta cryst., Vol. 13, Pt 2, 166-7 (Feb., 1960).

539.2 : 548.7

6370 X-RAY ANALYSIS OF FROZEN PYRIDINE AND ITS SOLUTION AT $-180^\circ C$. S.G.Biswas.

Indian J. Phys., Vol. 32, No. 1, 13-18 (Jan., 1958).

Debye–Scherrer patterns of pure pyridine and its solution in the frozen state at $-180^\circ C$ have been studied and two different patterns due to crystals of pyridine have been observed. Analysis of the patterns show that the first modification belongs to the space group Q^1_h with $a = 12.16$ A, $b = 9.14$ A, $c = 8.48$ A and the second modification belongs to the space group Q^4_h with cell dimensions $a = 11.00$ A, $b = 9.27$ A, $c = 9.02$ A. The density of the crystals has also been measured and the number of molecules in the unit cell is found to be 8 in both cases. It is shown that the pyridine molecule is asymmetric in both the modifications and that the formation of weak bonds among the molecules in the solid state may be the cause of such asymmetry. The frozen mixture is found to be amorphous. These results are compared with those of the investigations on the Raman spectra of crystals of pyridine and of frozen mixtures of pyridine by previous workers and it is concluded that complex groups of molecules produced new Raman band in the frozen mixtures.

VARIOUS SOLID STRUCTURES

539.213

6371 TETRAHEDRAL STRUCTURES IN AMORPHOUS CARBONS. S.Ergun and V.H.Tiensuu.
Acta cryst., Vol. 12, Pt 12, 1050-1 (Dec., 1959).

Calculations of intensity scattered at any angle 2Θ were made using Debye's formula for three molecules of 26 carbon atoms each arranged in a graphite-like layer, a diamond-type lattice and a hexagonal lattice. Broad diffraction peaks predicted on the basis of all three models fall in nearly the same positions and it is concluded that diffraction patterns alone are not sufficient to ascertain if graphite or diamond-like structures are present in amorphous carbons. J.Adam

539.213

6372 STRUCTURE IN VITREOUS SILICATE FIBERS AS SHOWN BY SMALL-ANGLE SCATTERING OF X-RAYS.
W.O.Statton and L.C.Hoffman.
J. appl. Phys., Vol. 31, No. 2, 404-9 (Feb., 1960).

The relation of the X-ray diagram at small angles to the preparation conditions of glass fibres from molten silicates is studied. The composition $Na_2O{\cdot}MgO{\cdot}3SiO_2$ is studied extensively, and fibres are also studied in which K_2O replaces Na_2O, and CuO and PbO replace MgO. Most of the diagrams are characterized by very intense, shaped diffuse scattering. Also, fibres which had certain thermal histories show intense, unshaped diffraction maxima. The diffuse scattering is interpreted as due to voids which are elongated by the spinning process. The discrete diffraction corresponds to a Bragg spacing of about 30 A but is not associated with short-range order. It is concentrated on the surface or accessible to liquid penetration from the surface. It is either frozen in by quenching, produced by quenching, or produced by a combination of quenching and reaction with the atmosphere. No interpretation of the structure responsible for it is given.

539.213

6373 NOTE ON THE PARAMAGNETIC RESONANCE OF IRON IN GLASS.
T.Castner, Jr, G.S.Newell, W.C.Holton and C.P.Slichter.
J. chem. Phys., Vol. 32, No. 3, 668-73 (March, 1960).

Fe^{+++} and Fe^{++} ions in glass were studied by means of paramagnetic resonance. The correlation of the Fe^{+++} concentration with an intense resonance at g = 4.27 shows the resonance is due to Fe^{+++}. A theory is proposed explaining the observed g value and the implications for the atomic surroundings of Fe^{+++} are discussed. It is also proposed that the g = 6 resonance observed in glass by Sands is due to Fe^{+++}.

539.213 : 541.18

CONTRIBUTION TO THE STUDY OF SOME PROPERTIES OF VITREOUS SILICA IN CONTACT WITH AQUEOUS SOLUTIONS: BEHAVIOUR OF SUSPENSIONS, ELECTROKINETIC MOBILITIES.
See Abstr. 4744

539.214

6374 LIGHT SCATTERING BY ANISOTROPIC INHOMOGENEITIES IN THIN POLYMER FILMS UNDER STRAIN. I. SIMPLE ELONGATION. H.L.Bhatnagar.
J. chem. Phys., Vol. 32, No. 3, 674-6 (March, 1960).

Inhomogeneities in thin polymer films are assumed to have two different polarizabilities, one longitudinal and the other transverse. A distribution function for orientation of these anisotropic inhomogeneities is obtained as a function of degree of strain and utilized to obtain average scattered intensity. Expressions for differential cross-sections of scattering which have been defined are derived.

539.214

6375 TRANSITIONS IN POLYMERS BY NUCLEAR MAGNETIC RESONANCE AND DYNAMIC MECHANICAL METHODS.
J.A.Sauer and A.E.Woodward.
Rev. mod. Phys., Vol. 32, No. 1, 88-101 (Jan., 1960).

A review, with 63 references, including information about polyisobutylenes, poly (methyl methacrylates), poly (vinyl chlorides), polyethylenes, polypropylenes, poly (butene-1), polystyrenes, polyamides and polytetrafluoroethylenes. The two methods sometimes give equivalent information, but often supplement each other. R.F.Barrow

539.214 : 536.41

6376 THERMAL EXPANSION OF FLUOROPLAST IV BETWEEN −190 AND 325°C.
I.E.Leksina and S.I.Novikova.
Fiz. tverdogo Tela, Vol. 1, No. 3, 504-11 (March, 1959). In Russian.

The linear expansion coefficient of Fluoroplast IV (industrial polytetrafluorethylene) was measured using samples of 2.28 g/cm³ density, annealed for 1 hour at 350°C. Two thermal expansion anomalies were observed on heating; one, very sharp, at 21.0 ± 0.5°C, and the other, much weaker, at 31.4 ± 0.5°C. On cooling the first peak was displaced towards lower temperatures (by 1.5°) but the second peak was unaffected. The change of the specific volume at 21°C amounted to 1.18% of the volume at 0°C; it was probably due to a transition of the first type. The change in the specific volume at 31.4°C was 0.18% of the volume at 0°C; it was probably due to a transition of the second type. A weak hump was found on the thermal expansion curve between −120 and −50°C. The expansion coefficients of non-annealed samples were 5-7% higher than those of annealed samples. A.Tybulewicz

539.214 : 535.55

PHOTOELASTIC EFFECT IN POLYMETHYL METHACRYLATE, POLYBUTYL METHACRYLATE AND POLYVINYL ACETATE. See Abstr. 5187

539.217

6377 CORRECTIONS APPLICABLE IN MERCURY POROSIMETER MEASUREMENTS. O.G.Ingles.
Austral. J. appl. Sci., Vol. 10, No. 4, 484-8 (Dec., 1959).

The paper enumerates the general corrections which should be applied to porosity measurements and discusses in particular these corrections when using a resistance wire measurement system. E.G.Knowles

539.219

6378 THE ORDERING OF TERNARY ALLOYS AS A COOPERATIVE PHENOMENON. O.Mdivani.
Acta phys. Polon., Vol. 16, No. 6, 415-21 (1957). In Russian.

It is shown that the partition function of a ternary alloy can be reduced to an Ising partition function only in the case of a linear lattice. Some simple conclusions are drawn about these alloys in the three-dimensional case, using the matrix method under the assumption of a long-range order; but it is pointed out that it is impossible at present to obtain more definite results because (1) the partition function cannot be directly reduced to the Ising type, and (2) to each lattice point there correspond three, and not two, configurations. Thus, the mathematical methods used in the study of the ordering of binary alloys cannot be used.

539.219

6379 THE PHASE DIAGRAM OF Zn–Sb. V.Tydlitat.
Czech. J. Phys., Vol. 9, No. 5, 638-40 (1959). In German.

Describes the results of X-ray analysis. The unit cell dimensions, the symmetry and the number of stoichiometric units in the unit cell are determined for β-Zn_4Sb_3. Zn_3Sb_2, obtained from the high-temperature phase by slow cooling to room temperature, is found to consist of β-Zn_4Sb_3 and Zn. J.Thewlis

539.219

6380 INVESTIGATION OF THE FINE STRUCTURE OF Al-Mg AND Ni-Cu SOLID SOLUTIONS.
N.I.Noskova and V.A.Pavlov.
Fiz. Metallov i Metallovedenie, Vol. 6, No. 2, 334-8 (1958).
In Russian.

Distortions caused by the atoms of the second component were determined by the method described in the papers of Il'ina, Kritskaya, Kurdyumov and Lysak [Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 17, No. 3, 297 (1953); Problemy Metallovedeniya i Fiziki Metallov, Vol. 2, 222 (1951) and Vol. 4 (1955)] on pure Al (with 0.0017% Fe, 0.0011% Si and 0.01% Mg), its alloys with 0.12 and 1.04% Mg, pure Ni, and its alloys with 10, 20, 40 and 60% Cu. In these solid solutions the distortions of the second kind increase as the proportion of the second component increases, while the fragmentation in the deformed state depends but little on the addition of the second component. Tentative explanation is given of the strength increase in the solid solutions tested. F.Lachman

539.219

6381 SOME ADDITIONAL INFORMATION REGARDING SOLID SOLUTIONS IN THE AlSb–GaSb SYSTEM.

I.I.Burdiyan.

Fiz. tverdogo Tela, Vol. 1, No. 9, 1360-5 (Sept., 1959). In Russian.

Polycrystalline specimens of high homogeneity were prepared for 5 intermediate compositions by zone levelling. Microhardness peaked at AlSb.GaSb (~460 kg/mm^2). From X-ray data lattice constants vary linearly with composition. Energy gaps deduced from optical absorption spectra were in excellent agreement with previously determined thermal activation energies. See also Abstr. 10295 (1959). C.H.L.Goodman

539.219

6382 THERMODYNAMIC PROPERTIES OF NONSTOICHIOMETRIC URANIA–THORIA SOLID SOLUTIONS.

S.Aronson and J.C.Clayton.

J. chem. Phys., Vol. 32, No. 3, 749-54 (March, 1960).

A solid state electrochemical technique was used to obtain thermodynamic information on urania–thoria solid solutions of compositions $U_yTh_{1-y}O_{2+x}$ with values of y of 0.9 to 0.3 and values of x of 0.02 to 0.16. The electrochemical cells were of the type Fe, FeO $|(ZrO_2 + CaO)|$ $U_yTh_{1-y}O_{2+x}$, Pt. Measurements were made at temperatures of 1150-1350°K. Partial molar free energies, entropies, and enthalpies of solution of oxygen in the solid solutions were calculated. The partial molar free energy decreases negatively with increasing thorium content for thorium concentrations greater than 30 atomic percent. The partial molar entropy increases negatively with increasing oxygen content or with increasing thorium content. The experimental results are discussed in connection with a mechanism of interstitial solution of oxygen ions in the fluorite lattice. A thermodynamic equation for the entropy is developed which gives semiquantitative agreement with the experimental data.

539.219

6383 LIQUIDUS–SOLIDUS RELATIONS IN THE SYSTEM IRON–ALUMINIUM. J.R.Lee.

J. Iron Steel Inst., Vol. 194, Pt 2, 222-4 (Feb., 1960).

The liquidus and solidus curves were determined accurately by thermal analysis. The addition of aluminium to iron produces a very slight rise in the freezing point but it is not possible to say whether this is a characteristic of the true binary equilibrium diagram, or whether it is due to the removal of the last traces of oxygen from the high-purity iron which was used for the experiments. The system contains two eutectics in the region 65-75 atomic % Al, and the previously accepted diagram is shown to be incorrect in indicating a peritectic horizontal.

539.219

6384 AN INVESTIGATION OF THE ZIRCONIUM-TANTALUM SYSTEM. V.S.Emelyanov, Yu.G.Godin and A.I.Evstyukhin.

J. nuclear Energy, Vol. 5, No. 2, 247-52 (1957). English translation of article in Atomnaya Energiya, Vol. 2, 42 (1957).

Metallography, X-ray diffraction, thermal analysis, electrical resistance and hardness measurements were employed in the study of the zirconium-tantalum system and the determination of its phase diagram. The diagram is a eutectic type and shows limited solubility in the solid state. The maximum solubility of tantalum in α-zirconium at 790°C is less than 0.22 at. per cent while β-zirconium will dissolve 16 at. per cent of tantalum at 1585°C. Maximum solubility of zirconium in tantalum is 17 at. per cent at 1585°C. The eutectic occurs at 1585°C and 34 at. per cent tantalum. A eutectoidal transformation of the solid solution based on β-zirconium takes place at 790°C; the eutectoidal composition is 7 at. per cent tantalum.

539.219

6385 STUDIES OF IRON-RUTHENIUM ALLOYS. W.Obrowski.

Naturwissenschaften, Vol. 46, No. 22, 624-5 (1959). In German.

A description is given of the phase diagram, including the crystal structure of the various phases.

B.T.M.Willis

539.219

6386 ON THE INFLUENCE OF VOLUME EFFECTS ON ORDER–DISORDER TRANSITIONS.

A.W.Ross and D.ter Haar.

Physica, Vol. 25, No. 10, 343-56 (May, 1959).

An attempt is made to study in a simplified model of a binary substitutional alloy the influence of the differences in atomic radii of the constituent atoms and in the potential energies of the various possible pairs of atoms. The theory is developed for linear, simple cubic, and body centred cubic lattices, and it is found that the order–disorder transition in the three-dimensional lattices can be either first or second order depending on the differences between the various potential energies. The results are applied to the case of β-brass. The agreement of theory with experiment is as good as can be expected from a theory involving necessarily a large number of simplifying assumptions. The effect of lattice vibrations on these results is considered briefly.

539.219 : 539.2 : 537.311

6387 AN INVESTIGATION OF THE Bi_2Te_3–Bi_2S_3 SYSTEM. M.L.Beglaryan and N.Kh.Abrikosov.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 1, 135-7 (Nov. 1, 1959). In Russian.

Alloys were prepared from the purified elements by melting in evacuated silica tubes, followed by prolonged annealing (530°C for Bi_2Te_3 rich alloys, otherwise 580°C). Bi_2Te_3 dissolves up to 4 mol. % Bi_2S_3; there is a further range of solid solutions from Bi_2Te_2S to 39 mol. % Bi_2S_3, this phase showing a maximum melting point at 35 mol. % Bi_2S_3 and 625.5°C, and forming eutectics with Bi_2Te_3 and Bi_2S_3 (at 6 mol. % Bi_2Te_3, 581°C; 40 mol. % Bi_2S_3 622°C). No solid solutions based on Bi_2S_3 were observed although alloys up to 98% Bi_2S_3 were prepared. Specimens of the Bi_2Te_2S phase were n-type with conductivities of 400-500 ohm^{-1}cm^{-1}, and of the Bi_2Te_3 phase p-type with conductivities falling (with increasing Bi_2S_3 content) from 400 to 60 ohm^{-1}cm^{-1}. Thermoelectric power and microhardness data were obtained. Bi_2Te_2S was found to have the tetradymite structure with a = 10.1 A, α = 24°8'. [See also Harker, Zeitschrift für Kristallographie, Vol. 89, 175 (1934)]. C.H.L.Goodman

539.219 : 539.2 : 537.3

INFLUENCE OF THE BREAKUP OF SUPERSATURATED SOLID SOLUTIONS ON THE HALL EFFECT. See Abstr. 6069

539.23

6388 ELECTRON DIFFRACTION INVESTIGATIONS OF THIN EVAPORATED METAL FILMS AND THEIR INTERPRETATION BY GAS INTERFERENCE THEORY. P.Midecke.

Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 3-4, 174-86 (1960). In German.

Gas interference theory is applied to anomalous electron diffraction patterns observed with thin metal films. Such films evaporated onto cooled surfaces contain fine crystallites as well as amorphous regions. Thin films of iron, gold and silver have been examined in an improved electron diffraction camera provided with a rotating sector disc with an aperture proportional to $\sin^3(\Theta/2)$ to facilitate accurate photometry. The results support the view that foreign atoms in such films occupy sites between the smallest crystallites rather than in them. A.E.I. Research Laboratory

539.23

6389 THE MEASUREMENT OF CRITICAL THICKNESS OF ALUMINIUM FILMS. V.Pučálka.

Czech. J. Phys., Vol. 9, No. 5, 668-9 (1959). In German.

The critical thickness referred to is that at which a finite electrical conductivity can be measured. The value measured in vacuum is smaller than that in air because oxidation will isolate particles which make good contact in vacuo. In vacuo the critical thickness is about 23 A and the transparency is about 73%.

A.H.W.Beck

539.23

6390 THERMAL CONDUCTIVITY OF CONDENSED FILMS: METHANE. J.T.Clarke and R.Gorden, Jr.

J. chem. Phys., Vol. 32, No. 3, 705-7 (March, 1960).

A new method of determining the thermal conductivity of condensed films at low temperature has been developed. It is based on determining the surface temperature of a film of known area and thickness by measuring its equilibrium vapour pressure. The thermal conductivity (K) of the film is calculated by measuring the increase in surface temperature as the film thickness is increased when a known heat flux is flowing across the film. For methane at 85°K, K = 3.5×10^{-3} W/cm deg K.

539.23

6391 EPITAXIAL GROWTH OF THIN FILMS. K.R.Dixit.

Proc. Indian Acad. Sci. A, Vol. 48, No. 6, 330-5 (Dec., 1958).

The two-dimensional gas theory of growth of thin metal films

(Abstr. 359 of 1934) is extended to epitaxial growth by introducing a van der Waal's type term depending on the attraction between the substrate ions and the deposited atoms. Growth by deposition of neutral atoms from solution and by electrolytic deposition of ions is considered. J.E.Caffyn

539.23 : 535.3

6392 STUDY OF A THEORETICAL STRUCTURAL MODEL TO REPRESENT A VERY THIN METALLIC FILM.
P.Dumontet and J.P.David.
C.R Acad. Sci. (Paris), Vol. 250, No. 3, 518-20 (Jan. 18, 1960).
In French.

Assuming that a thin metallic layer consists of discontinuous assemblies of atoms—"islets" whose lateral dimensions are comparable with their thickness—expressions are derived for the fields reflected and transmitted by the layer, when a plane electromagnetic wave strikes it at normal incidence. J.Thewlis

539.23 : 536.48

INFLUENCE OF ADSORBED GASES ON THE SUPERCONDUCTIVITY OF THIN THALLIUM FILMS. See Abstr. 5239

X-ray and Electron Microscope Examination

539.26

6393 X-RAY MICROBEAM STUDY OF DEFORMATION BANDS IN ALUMINIUM. D.Lewis.
Brit. J. appl. Phys., Vol. 11, No. 4, 162-4 (April, 1960).

An experiment has been devised to measure the relative contribution of plastic bending and mosaic structure to asterism formation. Adjacent X-ray microbeam photographs were taken across a broad deformation band in a crystal of aluminium and the total curvature (estimated from the asterisms) compared with that from a normal X-ray beam covering the same distance. It was shown that the asterism must be mostly due to fragmentation. Orientation determinations show that the raised portion of the band consists mainly of portions of the crystal that have not rotated in accordance with the theory of Taylor and Elam (Abstr. 2415 of 1925).

539.26

6394 NEUTRON STUDY OF THE TEXTURE OF DRAWN URANIUM RODS IN THE α-PHASE.
J.Laniesse, M.Englander and P.Mériel.
C.R. Acad. Sci. (Paris), Vol. 249, No. 23, 2576-8 (Dec. 9, 1959).
In French.

Describes the use of neutrons to determine the preferential orientation of U rods. Neutrons have a big advantage over X-rays for this purpose owing to their much lower absorption. J.Thewlis

539.27

6395 REFLEXION ELECTRON MICROSCOPY USING DIFFRACTED ELECTRONS.
J.S.Halliday and R.C.Newman.
Brit. J. appl. Phys., Vol. 11, No. 4, 158-62 (April, 1960).

Crystalline surfaces have been examined in the reflection electron microscope with the angles of illumination and viewing adjusted so that diffracted electrons contributed to the images. In this way, the size and distribution of the diffracting regions have been determined. A resolution of 80 A has been obtained, which is at least four times better than that obtained in normal reflection micrographs.

539.27

6396 EXAMINATION OF NYLON SPINNERET HOLES BY SCANNING ELECTRON MICROSCOPY. O.C.Wells.
J. Electronics and Control, Vol. 7, No. 4, 373-6 (Oct., 1959).

A method is described for the examination of small holes which has been applied to the study of a nylon spinneret. A resolution of 1000 A is demonstrated with the probable prospect of a five-fold improvement.

PHYSICAL CHEMISTRY

THERMOCHEMISTRY . REACTIONS

541.12

6397 RAPID CHEMICAL REACTION IN A LAMINAR BOUNDARY LAYER. S.K.Friedlander and M.Litt.
Appl. sci. Res. A, Vol 8, No. 6, 403-12 (1959).

A method is presented for determining the velocity, temperature, and concentration distributions, as well as the position of the reaction zone, near the surface of a burning fuel. The reaction is assumed to occur in the compressible laminar boundary layer on a flat plate. Variations in properties are allowed for subject to the requirements that the Prandtl and Schmidt numbers equal one and the density–viscosity product is a constant. A method is given for transforming from the boundary layer to the real coordinate system.

541.12

6398 STATIONARY DETONATION.
B.V.Voitsekhovskii.
Doki. Akad. Nauk SSSR, Vol. 129, No. 6, 1254-6 (Dec. 21, 1959).
In Russian.

Explosive gas mixtures are admitted to a ring-shaped tube at various points of the inner wall and ignited. A number of stationary explosion zones develop in such a way that the fresh gas mixtures fill wedge-shaped volumes which are bounded by the inner wall, a detonation front and an external current of combustion gas flowing past near the outer wall. The detonation fronts have propagation speeds which are multiples of the velocity of sound. Investigation by photographic methods reveals a complex structure and movement of the detonation front. R.Eisenschitz

541.12

6399 DETONATION PRESSURE OF LIQUID TNT.
W.B.Garn.
J. chem. Phys., Vol. 32, No. 3, 653-5 (March, 1960).

The plane steady-state detonation pressure behind the reaction zone of liquid TNT is reported. This pressure of 171.8 kilobars was established by measuring free-surface velocity as a function of plate thickness for 2024 aluminum plates placed in contact with the detonating explosive. The zero thickness metal shock pressure, obtained by extrapolating the free-surface velocity data, is corrected to the corresponding detonation pressure by an impedance matching calculation. Recording was done by a sweeping-image camera technique.

541.12

6400 ISOTOPE EXCHANGE PROCESSES IN SOLID NITROGEN UNDER ELECTRON BOMBARDMENT.
R.Klein and E.M.Hörl.
J. chem. Phys., Vol. 32, No. 1, 307-8 (Jan., 1960).

Mixtures of $N^{14}N^{14}-N^{15}N^{15}$ were used to investigate isotopic exchange under electron bombardment at 4° and 20°K, and a tentative interpretation is proposed. G.I.W.Llewelyn

541.12

6401 GENERALIZATION OF THE LAMINAR FLAME ACTION PRINCIPLE FOR ARRHENIUS-TYPE RATE FUNCTIONS.
G.Rosen.
J. chem. Phys., Vol. 32, No. 1, 311-12 (Jan., 1960).

Generalizes the principle obtained by the author (Symposium on Combustion, London, 1958, pp. 339, 412) by removing the restriction that the reaction rate expression vanishes at the cold boundary. J.Hawgood

541.12

6402 VARIATION WITH TEMPERATURE OF THE RECOMBINATION OF OXYGEN ATOMS ON A PLATINUM SURFACE. G.C.Fryburg and H.M.Petrus.
J. chem. Phys., Vol. 32, No. 2, 622-3 (Feb., 1960).

The recombination of oxygen atoms on a Pt surface was investigated at temperatures from 150°C to above 750°C. Three temperature regions were observed: (i) from 150 to 500°C, the rate of recombination was slow and constant and suggested an oxide surface; (ii) above 750°C much more rapid recombination occurred, again at a constant rate, indicative of a metal surface, and (iii) between 500 and 750°C behaviour was anomalous. G.I.W.Llewelyn

541.12

6403 **FORMATION OF EXCITED NO and N_2 BY WALL CATALYSIS.**

R.R.Reeves, G.Mannella and P.Harteck.

J. chem. Phys., Vol. 32, No. 3, 946-7 (March, 1960).

If a gas stream containing N and O atoms together with undissociated N_2 and O_2 is passed over Ni, Co or Ag, emission of a bright reddish light is observed in the gas phase adjacent to the metal. The suggested mechanism is

$$N(^4S) + O(^3P) \rightarrow NO(B^3\Pi), \text{ formed on wall and desorbs,}$$

followed by

$$NO(B^3\Pi) \rightarrow NO(X^1\Pi) + h\nu$$

or

$$NO(B^3\Pi_g)_{v=0} + N(^4S) \rightarrow N_2(B^3\Pi_g)_{v=8} + O(^3P),$$

$$N_2(B^3\Pi_g) \rightarrow N_2(A^3\Sigma_u^+) + h\nu.$$

It thus appears that electrically excited species are formed on the walls without deactivation. R.F.Barrow

541.12

6404 **ELECTRICALLY DISCHARGED CO_2 AS A SOURCE OF OXYGEN ATOMS.** E.A Ogryzlo and H.I.Schiff.

J. chem. Phys., Vol. 32, No. 2, 628-9 (Feb., 1960).

Possible reactions in electrically discharged CO_2 are discussed. O-atom concentrations of 5% of the CO_2 flow were observed.

G.I.W.Llewelyn

541.12

6405 **RATE OF RECOMBINATION OF OXYGEN ATOMS.** R.R.Reeves, G.Mannella and P.Harteck.

J. chem. Phys., Vol. 32, No. 2, 632-3 (Feb., 1960).

The techniques employed in overcoming the considerable experimental difficulties involved in the titrations necessary for measuring O atom concentration are discussed. The observed rate of recombination on a metal surface is 2.7×10^{-33} cm^6 molecules^{-2} sec^{-1} at 300°K and is largely independent of temperature.

G.I.W.Llewelyn

541.12

6406 **SOME CONSIDERATIONS OF UNIMOLECULAR RATE THEORY.** F.P.Buff and D.J.Wilson.

J. chem. Phys., Vol. 32, No. 3, 677-85 (March, 1960).

Examines the pressure dependence of the rate constant k of unimolecular decompositions within the framework of the generalized Lindemann mechanism. For trace amounts of reactive polyatomic molecules possessing very small equilibrium fractions of reactive states, the observed k may be identified with the lowest eigenvalue of the relaxation spectrum. After an examination of the Kassel and Slater microscopic decomposition frequencies (m.d.f.'s), this approach is applied to the strong collision mechanism which is a common feature of both theories. Finally, the lowest eigenvalue is calculated for the inefficient stepwise activation mechanism in combination with the simple Kassel m.d.f. The pressure dependence of k on a reduced basis is found to be relatively insensitive to the details of the activation mechanism employed. The effect of less efficient processes in the intermolecular energy transfer and of anharmonicities in the intermolecular energy transfer tend to broaden the transition range of k between the high- and low-pressure limits.

541.12

6407 **HYDROGEN ATOM ABSTRACTION REACTIONS BY CYANIDE ION-RADICALS.** T.W.Martin and C.E.Melton.

J. chem. Phys., Vol. 32, No. 3, 700-4 (March, 1960).

Ion-molecule reactions of low energy (0-0.15 eV) CHN^+ and CH_2N^+ are shown conclusively to follow a hydrogen atom abstraction mechanism of the type, $XH^+ + YH \rightarrow XH_2^+ + Y$. These reactions are presumably bimolecular being first order with respect to each reactant over the pressure range $10^{-7} - 10^{-3}$ mm Hg. The rates of these reactions are markedly influenced by the molecular structure of both the cyanide ion and the hydrogen donor (YH). Ion-molecule reactions of this type are similar to the hydrogen atom abstraction processes of free radicals, but differ in having no appreciable temperature coefficients (in the range of 100-215°C), and in having much larger rate constants. On the basis of this study, chemical species having unpaired electrons whether charged (ion-radicals) or uncharged (free radicals) are shown to undergo similar types of reactions. Possible implications of these observations to the field of radiation chemistry are discussed.

541.12

6408 **KINETIC STUDIES OF HYDROXYL RADICALS IN SHOCK WAVES. III. THE OH CONCENTRATION MAXIMUM IN THE HYDROGEN–OXYGEN REACTION.**

G.L.Schott.

J. chem. Phys., Vol. 32, No. 3, 710-16 (March, 1960).

For Pt II, see Abstr. 5219 (1959). The chemical reaction zone in shock waves in H_2–O_2–A mixtures was studied in detail using an ultraviolet line absorption technique to measure the OH radical concentration. The observed reaction course consists of an induction period followed by a sharp rise of [OH] to a maximum and then slow disappearance of OH. The [OH]maxima measured in rich, lean, and stoichiometric mixtures at $1000° \leq T \leq 2600°$K and over a sevenfold range of density show that the reaction occurs in two distinct steps. The intermediate condition, in which [OH], [H], and [O] reach values greatly in excess of their equilibrium ones, is approximately a state of equilibrium among the three independent bimolecular reactions which is reached before any significant recombination has occurred. The relationship of these results to experiments near the explosion limits and in flames is emphasized. The occurrence of this overshoot in atom and free radical concentrations, which is very pronounced in hydrogen–oxygen flames but is not observed in many hydrocarbon flames, is related to the decrease in number of moles which occurs in the oxidation of hydrogen but not of most other fuels.

541.12

6409 **VARIATION OF A CHEMICAL REACTION CROSS SECTION WITH ENERGY.**

E.F.Greene, R.W.Roberts and J.Ross.

J. chem. Phys., Vol. 32, No. 3, 940-1 (March, 1960).

Some initial results of molecular beam measurements of the energy dependence of chemical reaction cross-sections are given for the system $K + HBr \rightarrow KBr + H$. W.J.Orville-Thomas

541.12 : 681.142

6410 **AN ANALOG COMPUTER TO SIMULATE SYSTEMS OF COUPLED BIMOLECULAR REACTIONS.**

E.F.Macnichol, Jr.

Proc. Inst. Radio Engrs, Vol. 47, No. 11, 1816-20 (Nov., 1959).

An analogue computer has been constructed to simulate, as nearly as possible, the flux of material in systems of coupled chemical reactions. Concentrations of various reactants, intermediates and products are represented by the potentials at the outputs of electronic integrators. Rates of turnover of materials are represented by charges flowing to and from the integrators. The charges are caused to circulate by means of a "pump" mechanism that transfers charge at a rate proportional to the triple product of three voltages, two of which are derived from integrators and represent the concentrations of reactants. The third represents a rate constant. One voltage controls the frequency of an oscillator, the second, the duration of a triangular waveform, which is triggered by the oscillator, and the third, its rate of rise. By suitable interconnection of a number of integrators and pumps, a wide variety of reaction schemes can be simulated.

ELECTROCHEMISTRY

541.13

6411 **ON PECULIARITIES OF THE ELECTRO-OXIDIZING REACTION AT THE GERMANIUM ANODE.**

E.A.Efimov and I.G.Erusalimchik.

Dokl. Akad. Nauk SSSR, Vol. 128. No. 1, 124-6 (Sept. 1, 1959). In Russian.

A study of the effects of the presence in the electrolyte (0.1N HCl) of oxalic acid or KI. Both reduce the anodic potential of p-type Ge, particularly in the high current range where anodic attack is limited by the supply of holes. This is ascribed to the oxidation of $C_2O_4^{2-}$ or I^- by the injection of electrons, which gives rise to a field tending to attract holes to the surface. In the case of KI, free iodine produced was reduced again by the Ge and current efficiency was 100%. With CO_2 from oxalic acid no reduction occurred and efficiency was ~70%. (See also Abstr. 11002 of 1959).

C.H.L.Goodman

541.13

6412 **TRANSPORT NUMBERS IN PURE FUSED SALTS. THE ALKALI METAL CHLORIDES.**

F.R.Duke and A.L.Bowman.

J. Electrochem. Soc., Vol. 106, No. 7, 626-7 (July, 1959).

The transport number of the chloride ion has been determined in fused alkali chloride salts by a radiochlorine tracer technique, using a membrane cell. Values obtained are compared with theoretical predictions of Mulcahy and Heymann (1943) and of Sundheim (1956).

541.13 : 537.311 : 539.2

ELECTRODE PROCESSES IN THE SYSTEM SILICON MONOCRYSTAL/SODIUM HYDROXIDE SOLUTION. See Abstr. 6115

541.13 : 539.4

FLOW OF ELECTROLYTE WITHIN A PROPAGATING STRESS-CORROSION CRACK. See Abstr. 6319

PHOTOCHEMISTRY
RADIATION CHEMISTRY

541.14

6413 FREE RADICALS FROM THE FLASH PHOTOLYSIS OF PHENOL. L.I.Grossweiner and E.F.Zwicker.

J. chem. Phys., Vol. 32, No. 1, 305-6 (Jan., 1960).

The absorption spectrum of aqueous oxygen-free phenol solutions under irradiation was measured at various acidities. The different spectrum at pH 12-14 to that at pH 3-12 is attributed mainly to the phenoxy free radical. G.I.W.Llewelyn

541.14

6414 TRANSIENT SPECIES IN THE FLASH PHOTOLYSIS OF HALOGENS IN SOLUTION. N.K.Bridge.

J. chem. Phys., Vol. 32, No. 3, 945-6 (March, 1960).

Unidentified species are detected by their ultraviolet absorption spectra when Br_2 and I_2 are flashed in solution in normal sulphuric acid, carbon tetrachloride or hexane under conditions when there appears to be no reaction with solvent. R.F.Barrow

541.14

6415 PARAMAGNETIC RESONANCE IN LIGHT IRRADIATED SILVER BROMIDE. D.Büsnecker and W.Waidelich.

Naturwissenschaften, Vol. 47, No. 2, 35 (1960). In German.

A weak paramagnetic resonance is observed in silver bromide powder after long irradiation with a mercury lamp. It has width 400 gauss and g value 2.3 in contrast with silver chloride and it is thought to be due to a photochemical product. J.G.Powles

541.15

6416 CHANGE OF THE OPTICAL PROPERTIES OF BENZENE IRRADIATED BY GAMMA-RAYS.

S.V.Starodubtsev, M.N.Gurskii and A.G.Suzykh.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 2, 307-9 (Nov. 11, 1959). In Russian.

This effect provides an optical method for following changes in the material induced by radiation which is sensitive to a dose of 0.6×10^6 r. The luminescent spectrum over the visible region changes with dose in a heterogeneous manner and curves are given for doses of 8×10^6 r, 16×10^6 r, 25×10^6 r and 110×10^6 r. The plane of polarization of the light can be rotated by 0.7-0.9° over a path length of 10 cm for a dose of 10^7r. W.Bardsley

541.15

6417 RADIOLYSIS AND BOND STABILITY OF SQUALENE. H.Yamazaki and S.Shida.

J. chem. Phys., Vol. 32, No. 3, 950-1 (March, 1960).

Analysis of the products indicate that they may arise simply by breaking of the C—C bonds in squalene: those bonds are most easily broken which are calculated to be the weakest. R.F.Barrow

541.15

6418 ON THE RADIATION-INDUCED GAS-PHASE POLYMERIZATIONS OF ACETYLENE AND BENZENE. A.R.Jones.

J. chem. Phys., Vol. 32, No. 3, 953-4 (March, 1960).

Studies of infrared spectra, and other evidence, indicate that acetylene polymer (cuprene) consists of a three-dimensional network of benzenoid rings, probably joined by short conjugated aliphatic chains and acetylenic linages, with phenyl and HC≡C— end-groups. The spectrum of the benzene polymer is similar to that of irradiated polystyrene. R.F.Barrow

541.15

6419 SOME ASPECTS OF THE VULCANIZATION OF RUBBER BY IRRADIATION.

A.S.Kuzminskii, T.S.Nikitina and V.L.Karpov.

J. nuclear Energy, Vol. 4, No. 2, 268-72 (Feb., 1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 3, 137 (1956).

Describes the vulcanization by irradiation of the following types of rubber: natural rubber (NK), butadiene-styrene (SKS-30), butadiene (SKB-40), and nitrile (SKN-26). Changes in the relative density, structure, and strength were measured as a function of total irradiation dose. The effect of various additions to the rubber on the process of vulcanization by irradiation was investigated. The specific role of various types of carbon black and the importance of the degree of oxidation of the surface in this process were demonstrated.

541.15

6420 ELECTRON SPIN RESONANCE STUDY ON THE γ-RAY RADIATION EFFECTS IN HIGH POLYMERS.

K.Masuda and T.Suita.

Technol. Rep. Osaka Univ., Vol. 8, 227-32 (Oct., 1958).

Electronic structure changes of high polymers irradiated by γ-rays were studied by electron spin resonance. The g-factors were found to be 2.11 and 2.00 and the peak to peak line widths were 130 g and 760 g for irradiated Teflon and polystyrene, respectively. These data seem to suggest that there are some electronic structure differences between γ-ray and X-ray irradiated Teflon and deuteron beam bombarded Teflon.

541.15 : 532.7

6421 APPLICATION OF THE HIGH-SPEED ELECTRONIC COMPUTER IN DIFFUSION KINETICS. II. DEPLETION EFFECT IN THE SPHERICAL ONE-RADICAL ONE-SOLUTE MODEL. H.Fricke and D.L.Phillips.

J. chem. Phys., Vol. 32, No. 4, 1183-7 (April, 1960).

The earlier computations (Pt I, Abstr. 910 of 1959) are extended by taking account of the transient dilution of the solute which occurs during the reaction. Although the drop in concentration of the solute near the centre of the reaction zone may be considerable, its effect on the fraction of radicals combining with the solute is only of the order of one percent under the most unfavourable conditions likely to be encountered when the model is applied to γ-irradiated aqueous solutions.

DISPERSIONS . COLLOIDS
ADSORPTION

541.18

6422 SIZE DISTRIBUTION OF AIRBORNE DUST SAMPLES FROM BRITISH COALMINES.

J.W.J.Fay and J.R.Ashford.

Brit. J. appl. Phys., Vol. 11, No. 1, 1-13 (Jan., 1960).

Airborne dust was taken with the thermal precipitator and evaluated using the optical microscope. It was shown that many of the particles of less than 1 μ in diameter present underground are probably associated with atmospheric pollution, and do not arise directly from mining operations. Consideration was then given to the size distribution of the above 1 μ component of the dust. The results, recorded on special samples by the pneumoconiosis Field Research Unit, together with some published size-analyses of airborne dust in British and South African mines, are examined, and it is shown that a single-component exponential distribution provides a reasonably good fit to the observed data. The size distributions reported during routine sampling work at the 26 collieries associated with the research are then analysed in terms of the exponential distribution. It appears that within any given colliery there is no considerable variation in size distribution between facework on the coal-getting and preparation shifts and non-facework underground although there is a suggestion that the airborne dust encountered in hard headings may contain a higher proportion of smaller particles than in other parts of the same colliery. There are, however, marked variations from coalfield to coalfield, the coarsest dust being reported in South Wales and the finest in Scotland. The implications of these results are discussed and it is shown that the 1-5 μ particle number count is a satisfactory parameter for the measurement of the hazard associated with airborne dust.

541.18

6423 STUDY OF CHEMISORPTION AND PHOTODESORPTION ON OXIDIZED TITANIUM.

P.Weulersse, M.Balkanski and P.Aigrain.

C.R. Acad. Sci. (Paris), Vol. 250, No. 7, 1246-8 (Feb. 15, 1960). In French.

The differences of potential between a titanium electrode covered by the thin film of oxide formed spontaneously in air at normal temperature (thickness about 30 A) and a platinum reference electrode, are registered during and after illumination of the surface by ultraviolet light. The data obtained give the rates of variation of density of the surface ions, and are applied to the respective cases of photodesorption and chemisorption which occur. The results confirm the theory of chemisorption proposed by Aigrain and Dugas [Z. Elektrochem., Vol. 56, 363 (1952); cf. Hauffe and Engel (ibid, p. 366)] and developed subsequently by Thuillier (thesis, Faculté des Sciences, Paris, 1958). H.H.Hodgson

541.18

6424 INTERACTION OF HYDROGEN WITH TUNGSTEN. T.W.Hickmott.

J. chem. Phys., Vol. 32, No. 3, 810-23 (March, 1960).

Measurements were made under ultra-high vacuum conditions of the rates and isotherms for the adsorption of hydrogen on tungsten, the rate of desorption of hydrogen from tungsten, and the rate of formation of atomic hydrogen by an incandescent tungsten filament. When hydrogen chemisorbs on tungsten at 77°, the sticking probability is 0.1 and two distinct states of binding, α and β, may be isolated at adsorption pressures as low as 2.5×10^{-9} mm. Analysis of hydrogen chemisorbs as atoms since evaporation is second order in adsorbed hydrogen. For $n_\beta < 30 \times 10^{12}$ molecules/cm^2, adsorbed hydrogen. For $n_\beta < 30 \times 10^{12}$ molecules/cm^2, $\nu_M = (5 \times 10^{-5})n^2 \exp(-31\,000/RT)$ molecules/cm^2 sec. At higher coverages, a decrease in heat of desorption is observed which is due to surface heterogeneity. At equilibrium, the amount adsorbed in the β state obeys a Temkin isotherm between 273° and 373°K; evaporation of hydrogen in the β-state occurs down to temperatures as low as 77°K. Isosteric heats agree with heats derived from desorption measurements. The α state, populated before the β state is saturated at 77°K, is proportional to hydrogen pressure and probably consists of molecular hydrogen on top of the primary atomically chemisorbed layer. The rate of evaporation of atomic hydrogen when the filament temperature is raised above 1100°K is $\nu_A = (2.2 \times 10^{13})n \exp(-67\,000/RT)$ molecules/cm^2 sec. For purpos pressures below 10^{-7} mm and filament temperatures above 1475°K, the fraction of molecules striking the filament surface that is dissociated is constant and at least 0.05. Values of surface coverage and the rate of formation of atomic hydrogen as a function of filament temperature and hydrogen pressure are derived from experimental data.

541.18

6425 A TEST OF THE BECKER–DOERING THEORY OF NUCLEATION KINETICS. W.I.Higuchi and C.T.O'Konski.

J. Colloid Sci., Vol. 15, No. 1, 14-49 (Feb., 1960).

Intensive consideration was given to the possibility of developing a method for studies of gas-phase nucleation which would be better than the usual cloud-chamber techniques. The method selected and developed involves steady-state production of nuclei in a turbulent jet where a dilute vapour issuing from a nozzle is rapidly quenched by a cooler annular gas stream. The nuclei are grown, and the resulting aerosol particles are electronically counted by means of light-scattering instrumentation. Equations are developed for the rate of production of nuclei in the jet under steady-state conditions. With their application, the pre-exponential and exponential factors of the Becker–Doering equation were separately determined from data on dibutyl phthalate (DBP), triethylene glycol (TEG), and n-octadecane (OCD). Heterogeneous nucleation was observed with DBP, OCD, and sulphur vapour. A critical resume of the Becker–Doering theory is given. Large deviations from the theory observed with TEG are discussed in relation to the effects of hydrogen bonding on the structure of the critical nucleus.

541.18

6426 TEMPERATURE DEPENDENCE OF THE HIGH HYDROGEN CONCENTRATION IN NICKEL LAYERS. B.Baranowski.

Naturwissenschaften, Vol. 46, No. 24, 666 (1959).

The hydrogen absorbed in an electrolytically deposited layer of Ni 15μ thick is found to decrease at 25°C rather suddenly from about 0.7 (atomic ratio H/Ni) to zero at about 60°C. A slight hysteresis appears when the nickel layer (charged by cathodic hydrogen) is decreased in temperature, the hydrogen concentration being higher when coming from the lower to the higher temperature. W.Good

541.18

6427 SORPTION OF HYDROGEN BY TITANIUM AND ZIRCONIUM AT LOW PRESSURES. E.A.Ab, R.I.Plotnikov and L.A.Khutsishvili.

Zh. tekh. Fiz., Vol. 29, No. 9, 1146-51 (1959). In Russian.

Qualitative data were obtained on the rate of sorption (V) of H by wrought, powdered and vacuum-deposited Ti and Zr, and on the sorption capacity of these metals. All the materials investigated already acted as H-getters at room temperature, but the highest values of $V \cong 2$ litres sec^{-1} cm^{-2} were attained by the Ti and Zr powders at 150-200°C. Since V was not affected by the variation of pressure in the 10^{-4} - 10^{-3} mm Hg range, it was concluded that diffusion of adsorbed H into Ti and Zr was not a factor determining the magnitude of V. The results obtained indicated that Zr and Ti can be effectively used as H-getters in vacuum practice. M.H.Sloboda

541.18 : 537.533

FIELD EFFECTS ON CHEMISORBED FILMS IN ELECTRON EMISSION MICROSCOPY. See Abstr. 5356

541.18 : 539.4

THE CHANGE IN THE MECHANICAL PROPERTIES OF TIN SINGLE CRYSTALS UNDER THE INFLUENCE OF A STRONG ADSORPTION ACTIVE MEDIUM. See Abstr. 6313

PHYSICAL METHODS OF CHEMICAL ANALYSIS

545

6428 UTILIZATION OF GLIDING SPARKS FOR SPECTROCHEMICAL ANALYSIS IN THE FAR ULTRAVIOLET. POSSIBILITY OF DETECTION AND DETERMINATION OF PHOSPHORUS IN COPPER AND IN THE ALLOYS OF ALUMINIUM. J.Romand and G.Balloffet.

J. Phys. Radium, Vol. 18, No. 11, 641-2 (Nov., 1957). In French.

Some experimental details of a spectrochemical method for the quantitative determination of phosphorus are given. Precision comparable to chemical techniques is claimed. G.I.W.Llewelyn

545 : 531.75

CONTINUOUS READING BALANCE FOR OXIDATION STUDIES. See Abstr. 4984

GEOPHYSICS

550.3

6429 A REVIEW OF GEOPHYSICAL INSTRUMENTATION. W.T.Born.
Geophysics, Vol. 25, No. 1, 77-92 (Feb., 1960).

A historical review of the development of instrumentation used in all phases of geophysical prospecting, including well logging. 49 references.

550.3

6430 SEISMOGRAM SYNTHESIS INCLUDING MULTIPLES AND TRANSMISSION COEFFICIENTS.
P.C.Wuenschel.
Geophysics, Vol. 25, No. 1, 106-29 (Feb., 1960).

Synthetic seismograms that include multiples and transmission coefficients have been obtained by solving the boundary value problem for the multilayered half-space exactly for the plane wave case at normal incidence. The computations of four seismograms of interest have been programmed for the IBM 704. The seismograms differ in location of source and detector, i.e. whether buried or at the surface of the half-space and whether or not this surface is a stress-free surface. Evaluation of the computer programmes prior to synthesizing seismograms is accomplished by comparing computer with analytical solutions of simple problems. The significance of multiples to the total reflected signal depends on the vertical distribution of acoustic impedance. For small contrasts in acoustic impedance distributed throughout the section, multiples are relatively insignificant. For moderate contrasts similarly distributed, multiples can produce discrete events, cause phase shifts in large amplitude direct reflections, and alter the frequency of weak direct reflected signal. If the near-surface contrasts are large, then multiples within these layers can mask a direct reflected signal from depth by producing "ringing" or "wave training". The present analysis gives a more reasonable explanation of "ringing" records than has been given heretofore. It is evident when comparing synthetic seismograms, including multiples with field seismograms, that the predicted multiple contribution in many cases is greater than actually present, indicating that the mathematical model on which computation is based is not yet adequately realistic.

550.3

6431 MAGNETIC PROPERTIES OF ANISOTROPIC ROCKS. M.A.Grabovsky.
Ann. Geophys., Vol. 15, No. 1, 119-21 (Jan.-March, 1959).

550.3

6432 THE PROBLEM OF THE FORMATION OF REMANENCE WITH AN OPPOSITE POLARITY IN ROCKS.
Ann. Geophys., Vol. 15, No. 1, 121 (Jan.-March, 1959).

550.3

6433 ON THE HYPOTHESIS THAT THE MEAN GEOMAGNETIC FIELD FOR PARTS OF GEOLOGICAL TIME HAS BEEN THAT OF A GEOCENTRIC AXIAL MULTIPOLE. S.K.Runcorn.
J. atmos. terrest. Phys., Vol. 14, No. 1-2, 167-74 (April, 1959).

There are strong theoretical reasons for postulating that the mean geomagnetic field is symmetrical about the axis of the earth's rotation. The possibility that for parts of geological time the mean field has not been dipolar, but has had multipolar components, has not hitherto been discussed. Palaeomagnetic observations from North America, Australia and Europe are discussed in relation to this hypothesis but it is shown that continental drift is the more satisfactory inference to be drawn from the discrepancies between the polar wandering paths for the different continents.

550.3

6434 GEOMAGNETIC ACTIVITY FOLLOWING LARGE SOLAR FLARES. C.S.Warwick and R.T.Hansen.
J. atmos. terrest. Phys., Vol. 14, No. 3-4, 287-95 (June,1959).

Superposed epoch analysis of geomagnetic index around day of occurrence of large central flares shows a significant increase in geomagnetic activity following flares selected according to: (a) area of the flare and (b) "importance" of the flare. The association does not extend to flares of lesser importance, 2. During the period 1950-1954, near sunspot mimimum and roughly the same period studied by Watson, there was no tendency for geomagnetic disturbance to follow within 2-3 days after the fourteen reported class 3 and 3+ flares.

550.3

6435 MICROPULSATIONS IN THE EARTH'S MAGNETIC FIELD SIMULTANEOUS WITH PULSATING AURORA.
W.H.Campbell.
Nature (London), Vol. 185, 677 (March 5, 1960).

Some preliminary results have been obtained from an investigation being undertaken at College, Alaska, concerning the correspondence of the earth's magnetic field micropulsations with pulsating aurora for the purpose of explaining the physical mechanism giving rise to the phenomena. Two figures are given. One illustrates the nightly coincidence of micropulsations, measured with a 6 ft diameter magnetic north axis loop antenna of 21 586 turns and 3914 A auroral pulsations from 70° of sky measured with a lens, interference filter, photo-multiplier system. The other shows an occasion of simultaneous oscillations from the two phenomena.

550.3 : 551.5

DIURNAL VARIATION OF THE GEOMAGNETIC DISTURBANCE AT N.Z. ANTARCTIC STATIONS. See Abstr. 4814

550.3 : 551.5

6436 CHARACTERISTIC INTERVALS OF OSCILLATIONS WITH DECREMENT PERIOD OF 10-1 SEC IN THE ELECTROMAGNETIC FIELD OF THE EARTH, AND THEIR RELATIONSHIP TO PHENOMENA IN THE UPPER ATMOSPHERE.
V.A.Troitskaya and M.V.Mel'nikova.
Dokl. Akad. Nauk SSSR, Vol. 128, No. 5, 917-20 (Oct. 11, 1959).
In Russian.

Characteristic intervals of oscillations with ultra-short period (which, as assumed at present, are the morphological type of disturbances in the terrestrial electromagnetic field, that has direct correlation with the development of large-scale disturbances in the upper layers of the atmosphere) were detected on rapid recordings of telluric currents, taken at 17 Soviet stations (2 in Antarctica, 5 in Arctica, 10 in middle latitudes). The most characteristic elements of the ultra-short period oscillations are those with periods of 2-4 sec; they can last for several tens of minutes without decaying. The pictures of the development and trends of the oscillations, as observed during several magnetic storms in the IGY, were very close to each other in all 17 stations, and confirmed the assumption referred to above, relating to correlation with disturbances in the ionosphere and with the development of polar lights in lower latitudes.
F.Lachman

550.3 : 536.5

THERMAL DISTURBANCE IN HOT GROUND PRODUCED BY A TEMPERATURE-MEASURING PROBE. See Abstr. 5218

ATMOSPHERE . IONOSPHERE

(Abstracts on radiowave propagation in ionised media will also be found under Electromagnetic Waves)

551.5

6437 FREEZING NUCLEUS MEASUREMENTS IN JANUARY 1957. E.G.Bowen.
Austral. J. Phys., Vol. 11, No. 3, 452-5 (Sept., 1958).

Measurements were made daily in Jan. 1957 at ground level of the temperature at which a concentration of 0.1. freezing nuclei per litre of atmospheric air occurred at 6 stations in Australia and 2 in U.S.A. At 5 stations three maxima occurred on approximately the same dates while at another additional maxima occurred. Two stations were under the influence of a tropical cyclone and showed differences. In combining the results for all 8 stations maxima occur on Jan 15, 25 and 31. The dates are consistently later that for observations in 1954-56 but although variations exist from one locality to another there is a similarity for northern and southern hemispheres.
R.S.Read

551.5

6438 THE SPACE ENVIRONMENT. H.E.Newell, Jr.
Science, Vol. 131, 385-90 (Feb. 12, 1960).

Review article of information taken from satellite and rocket measurements.

551.5

6439 ON THE GENERAL THEORY OF THERMAL AND GRAVITATIONAL EXCITATION OF ATMOSPHERIC OSCILLATIONS. F.Mariani.
Ann. Geofis., Vol. 12, No. 4, 497-514 (Oct.-Dec., 1959).

Reconsiders the general theory of atmospheric tidal oscillations, assuming the correct height variation of the earth's radius vector R and of the acceleration due to gravity g. The fundamental tidal equation is solved separately for the case of purely gravitational and purely thermal oscillations. In the condition of resonance, the pressure oscillation p is substantially identical in the two cases; with respect to the classical case of constant R and g, the resonance period in the present generalized case is some minutes greater than the period calculated by Wilkes (Abstr. 7478 of 1959), and the resonance spectrum, as a whole, exhibits a slight shift. The amplitude of p is approximately 1.5 times smaller than in the case of Wilkes; an important feature is that the height of the nodal point of the pressure oscillation p, i.e. the height at which the sign of p is changed, is considerably greater in the present case (~ 80 km) than in Wilkes' case (~ 35 km).

551.5

6440 A CLOSED SOLUTION OF THE TURBULENT DIFFUSION EQUATION. O.S.Berlyand.
Dokl. Akad. Nauk SSSR, Vol. 130, No. 3, 526-9 (Jan. 21, 1960). In Russian.

Postulating, among others, a z-dependence (z is the vertical coordinate from the earth's surface) of the vertical component of the wind velocity, the author is able to separate the turbulent diffusion equation and hence to solve the ordinary equation for gas density using Laplace's transform, obtaining thus a closed integral solution. The dependence of the ground density on the asymptotic (with height) value of vertical wind velocity is also discussed.

J.K.Skwirzynski

551.5

6441 COSMIC-RAY PRODUCED RADIOACTIVE ISOTOPES AS TRACERS FOR STUDYING LARGE-SCALE ATMOSPHERIC CIRCULATION. B.Peters.
J. atmos. terrest. Phys., Vol. 13, No. 3-4, 351-70 (Feb., 1959).

In the interval between two consecutive condensations of moisture, atmospheric air accumulates radioactive isotopes produced by cosmic-ray particles in collisions with nitrogen, oxygen and argon. The production rates of these isotopes per gram of air depends strongly on altitude and latitude; the rate of removal depends, between rains, essentially on the half-life of each isotope. These facts can be used to label air masses and to trace their trajectories. The isotopes which seem to be most useful for meteorological investigations are: P^{32} (half-life 14 days); P^{33} (25 days); Be^{7} (53 days); and S^{35} (87 days). Their concentrations have been studied in rains in India during 1956-1957 and approximate values have been obtained for the annual fall-out. These experimental fall-out values have been compared with the values which one calculates from the expected isotope production by cosmic radiation in various parts of the atmosphere, and the following conclusions drawn. (1) The fall-out based on the annual production of the isotope Be^{7} agrees well with the measured annual fall-out. The measured fall-out of P^{32} is somewhat higher and that of P^{33} and S^{35} between two and five times higher than the calculated values. (2) The data indicate that condensation of water vapour removes cosmic-ray induced radioactivity from the air very efficiently. (3) Stratosphere air differs markedly from air which has remained in the troposphere throughout the period between successive condensations and precipitations; apart from the fact that its level of activity will in general be higher, it contains a much larger proportion of long-lived compared to short-lived isotopes. Air which has descended from the stratosphere and moves into lower regions, remains clearly distinguishable for very long periods. The simultaneous determination of radioactivity due to two or more isotopes in an individual rain leads, therefore, to information on the past history of the air mass from which the water was condensed. (4) A detailed analysis of twenty-one rain samples from various parts of India, taken between July and December 1957, showed that none of the corresponding air masses had the characteristics of air which had descended from the stratosphere.

551.5 : 532.5 : 536.25

NOTE CONCERNING THE INFLUENCE OF ROTATION ON CONVECTION. See Abstr. 5208

551.5 : 550.3 : 523.74

6442 GEOMAGNETIC, AURORAL, IONOSPHERIC, AND COSMIC RAY PERTURBATIONS: INTERDEPENDENCE AND RELATION TO SOLAR ACTIVITY.
F.Mariani and F.Molina.
Ann. Geofis., Vol. 12, No. 3, 297-368 (1959). In Italian.

A critical exposition, from both phenomenological and theoretical aspects, of the whole field. All these phenomena are different terrestrial effects of some electromagnetic phenomenon in the sun. The present paper is the first part of Pt I and the subject is a summary of present knowledge of magnetic storms. 84 references.

J.M.Hough

551.5 : 550.3 : 523.74

6443 GEOMAGNETIC, AURORAL, IONOSPHERIC, AND COSMIC RAY PERTURBATIONS: INTERDEPENDENCE AND RELATION WITH THE SOLAR ACTIVITY.
F.Mariani and F.Molina.
Ann. Geofis., Vol. 12, No. 3, 389-437 (1959). In Italian.

See preceding abstract. This section deals with the experimental knowledge of polar aurora. 88 references.

J.M.Hough

551.5 : 550.3

6444 A STUDY OF THE EQUATORIAL ELECTROJET. I. AN EXPERIMENTAL STUDY. C.A.Onwumechilli.
J. atmos. terrest. Phys., Vol. 13, No. 3-4, 222-34 (Feb., 1959).

An account is given of the photographic registration of the variation of the earth's horizontal magnetic force (H) across the magnetic equator in Nigeria from November 1956 to January 1957. As the period was magnetically quiet and the records were good, it has been possible to make a detailed study of the quiet day variation. The latitude of the maximum range of H was found to be about 0.5° from the magnetic towards the geographic equator. The daily variation curve of H is found to change its form as the magnetic equator is crossed from south to north and a method is introduced for the study of this change. It is shown that the fluctuations in H-variation curve characteristic of equatorial stations occur at the same time and in the same form at equatorial stations that may be distant from one another. The magnitudes of the same fluctuation at two stations are in about the same ratio as the daily ranges at the stations. It is thus likely that the indentations in the H-variation curve arise from fluctuations in the ionizing agent from the sun.

551.5 : 550.3

6445 A STUDY OF THE EQUATORIAL ELECTROJET. II. A MODEL ELECTROJET THAT FITS H-OBSERVATIONS. C.A.Onwumechilli.
J. atmos. terrest. Phys., Vol. 13, No. 3-4, 235-57 (Feb., 1959).

Methods are developed for separating the observed variation of the horizontal magnetic force (H) into its two component parts — the effect of the equatorial electrojet and the "normal variation" without the electrojet. It is shown that in such a separation, it is necessary to allow for the possible phase difference between the two component parts. Theoretical curves from the electrojet regarded as a horizontal current band of uniform intensity are found to fit the experimental points reasonably well. The electrojet is found to have a height of from 100 to 125 km, a width of 4° latitude and the current intensity at the height of 100 km is 6700 A/degree latitude. The effect of the electrojet on the vertical component (Z) of the earth's magnetic field is found to have a maximum value at about 250 km from the jet. It is shown that after 600 km from the electrojet, the H-effect of the jet becomes very small whereas the Z-effect is large enough to explain the large Z-ranges observed in such regions. The geographical distribution of the forms of H-variation curve across the magnetic equator is explained as a result of the superposition of the "normal" variation and the electrojet effect. It is pointed out that Z-ranges observed at various parts of the world near the magnetic equator indicate a lack of symmetry about that equator and this is explained with a theory developed in this paper. Some suggestions are given about the relative importance of the geographic, magnetic, and geomagnetic equators in geomagnetic variation.

551.5

6446 A RAPID METHOD OF OBTAINING ACCURATE VIRTUAL HEIGHTS FROM AN IONOGRAM. W.R.Piggott.
J. atmos. terrest. Phys., Vol. 14, No. 1-2, 175-7 (April, 1959).

A transparent slider is described which corrects the virtual height on an ionogram for changes due to varying echo amplitude and which enables accurate virtual heights to be obtained rapidly.

551.5

6447 "CHAPMAN BEHAVIOUR" IN THE LOWER IONOSPHERE. C.H.Cummack.
J. atmos. terrest. Phys., Vol. 14, No. 3-4, 229-35 (June 1959).

It is shown that Chapman's relations for the variation of critical frequency and height of a layer with solar zenith angle can be applied to any point on that layer and that it is not necessary to assume monochromatic radiation. These results are then applied to electron density versus height profiles and it is shown that "Chapman behaviour" can be detected to a height of 160 km being consistent with a scale height of 10 or 15 km.

551.5 : 621.391.812.63

6448 ELECTRON DENSITIES OF THE IONOSPHERE UTILIZING HIGH-ALTITUDE ROCKETS.
O.C.Haycock, J.I.Swigart and D.J.Baker.
I.R.E. Trans Antennas and Propagation, Vol. AP-7, No. 4, 414-18 (Oct., 1959).

The problem of determining the electron densities in the E-region of the ionosphere is approached by using 6 Mc/s pulse transmissions from a rocket to several ground receiving stations. A logical and complete development, using dyadic techniques is given for obtaining the propagation constant of the dissipative, anisotropic ionosphere. Special cases of the magneto-ionic formulae are given, and comparison of the ionosphere with a distributed-constant transmission line is made. In a nondissipative ionosphere, formulae are developed establishing the relationship between the effective electron density and the relative transmission delay of the 6 Mc/s pulse. A description of the University of Utah's vertical incidence experiment is given in which a 6 Mc/s pulse from an airborne transmitter is received simultaneously at several ground receiving stations. The relative 6 Mc/s time-delay data from three Aerobee high-altitude rockets launched from Holloman Air Development Centre on July 1, 1953, November 3, 1953 and June 13, 1956, were obtained and, from these, electron density was calculated. Curves showing the profile of electron density as a function of altitude as calculated both during the rocket ascent and descent are presented. The curves indicate a general increase of electron density throughout the E-region, rising from nearly zero at 85 km to a maximum of about 2×10^{11} electrons/m^3. The maximum altitude attained by the rockets allowed exploration up to 137 km above sea level.

551.5

6449 THE ELECTRON DENSITY DISTRIBUTION IN THE OUTER IONOSPHERE DERIVED FROM WHISTLER DATA. G.McK. Allcock.
J. atmos. terrest. Phys., Vol. 14, No. 3-4, 185-99 (June, 1959).

A method, using successive approximations, is given for finding the variation of electron density N with height h in the outer ionosphere, when the variation of whistler dispersion with geomagnetic latitude is already known. From the application of the method to specific whistler data, it is inferred that the electron density distribution in the outer ionosphere decreases exponentially with height at least in the height range 1000 to 13 000 km, and that during the period January to May 1957 the equation describing the distribution within this height range was: $N \approx 5.75 \times 10^4 \exp(-h/2640)$ where N is in cm^{-3} and h in km.

551.5

6450 EFFECT OF VERTICAL DRIFTS ON THE NOCTURNAL IONIZATION OF THE LOWER IONOSPHERE.
M.N.Rao and A.P.Mitra.
J. atmos. terrest. Phys., Vol. 13, No. 3-4, 271-90 (Feb., 1959).

Effect of vertical ionic drift velocities on the night-time ionization density in the lower ionosphere for heights ranging between 80 and 130 km is studied by a method of successive approximation. Values are also given of the effective recombination coefficient as a function of height and time for these drift velocities. Velocities ranging from 1 to 20 km hr^{-1} are used. The resultant ionization profiles for velocities 1-5 km hr^{-1} represent magnetically quiet conditions, while those for higher velocities would represent disturbed conditions of increasing severity. It will be noted that the ionization density decreases for upward drift and increases for downward drift. The present work provides a quantitative explanation of the sudden cessation of night-time echoes of low-frequency radio waves at times of magnetic disturbances, such as those observed at the Pennsylvania State University (Lindquist, Abstr. 9819 of 1954).

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6451 IONOSPHERIC CHANGES AT SINGAPORE DURING THE SOLAR ECLIPSE OF 14 DECEMBER 1955.
C.M.Minnis.
J. atmos. terrest. Phys., Vol. 13, No. 3-4, 346-50 (Feb., 1959).

The E- and F1-layer data obtained at pairs of stations during the eclipses of 1952 and 1954 were consistent on each occasion with a single model for the distribution of sources of ionizing radiation on the sun. The results obtained at Singapore in December 1955 cannot be explained in terms of any likely distribution. It seems possible that vertical movements, and the consequent invalidity of the Chapman theory, may have been responsible for this discrepancy. No significant change occurred in the critical frequency of the F2-layer but there is evidence of a complex redistribution of ionization in the lower part of the F-layer.

551.5 : 523.74

6452 SOME INDICES OF SOLAR ACTIVITY BASED ON IONOSPHERIC AND RADIO NOISE MEASUREMENTS.
C.M.Minnis and G.H.Bazzard.
J. atmos. terrest. Phys., Vol. 14, No. 3-4, 213-28 (June, 1959).

The critical frequencies of the E- and F2-layers of the ionosphere are closely controlled by the level of solar activity but, at any fixed point on the earth's surface, they also vary with season owing to the annual change in the solar zenith angle. A critical frequency can only be used to provide an index of solar activity if such seasonal variations can be eliminated or reduced to very small proportions. Methods of achieving this are described and monthly mean values of an E- and an F2-layer index are tabulated for the period 1938-1957. The correlation of these indices with each other and with the solar noise flux at λ10.7 cm is high. Some possible practical applications of such indices are discussed briefly.

551.5 : 621.391.812.63

6453 INVESTIGATION OF THE SCATTERING OF RADIO WAVES AT METRIC WAVELENGTHS IN THE LOWER IONOSPHERE. T.Hagfors.
Geofys. Publ., Vol. 21, No. 2, 58 pp.(1959).

An outline is given of the experimental and theoretical knowledge on the scattering of metric waves in the lower ionosphere as observed over an oblique path. It is shown that there still is considerable disagreement on the question of the mode of propagation involved. Some workers ascribe most of the signal to reflection from meteor trails. Others believe in various types of scattering from electronic irregularities due to turbulence, and yet others maintain that partial reflections from gradients in mean electron density may explain the signal. The partial reflection theory is discarded as very improbable for theoretical reasons. The application of radio interferometer technique is then shown to be well suited for deciding whether turbulent scattering or meteor trail reflection is the dominant mechanism. This technique is applied to an 1180 km test circuit at 46.8 Mc/s, and it is shown that turbulent scattering is dominant in the continuous signal, but that a fraction of the continuous signal power is due to meteor reflections. The spatial power spectrum of electronic irregularities at a height of about 85 km is shown to follow approximately an inverse power law in the wavenumber k of the form k^{-9}. For the neutral gas this implies that wavenumbers $k < 0.35$ m^{-1} are probably within the "dissipation range" of the similarity region of the velocity spectrum of homogeneous turbulence. The typical r.m.s. turbulent velocity encountered is about 10 m/s, and the turbulence is approximately isotropic.

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6454 SOME POSSIBLE EFFECTS CAUSED BY STRONG GYRO-WAVES IN THE IONOSPHERE. I. V.A.Bailey.
J. atmos. terrest. Phys., Vol. 14, No. 3-4, 299-324 (June, 1959).

The possible increases of collision frequencies ν and electron densities n caused by a powerful extraordinary circular gyro-wave in the nocturnal lower E-region and in the day-time D-region are investigated on the basis of available laboratory experiments on electrons in air and data concerning these regions. The resultant effects of such increases on this wave and on other waves are then examined. It is found that some of these effects are remarkable in magnitude or in kind. Thus, notable self-distortion of gyro-waves and extremely large wave-interaction can be caused by such an extraordinary wave when the reduced equivalent electric force Z/p which it produces in the nocturnal lower E-region has the value 2.5 V/cm per mm Hg measured at room temperature. Other possible detectable effects

which may be caused at night when Z/p has a value between 2.5 and 8 include changes in the airglow and in parts of some trails of meteors and fast particles of solar or cosmic origin, changes in radar echoes from such trails and transient changes in the local magnetic elements.

551.5

6455 GEOMAGNETIC DISTORTION OF REGION-E. W.J.G.Beynon and G.M.Brown.
J. atmos. terrest. Phys., Vol. 14, No. 1-2, 138-66 (April, 1959).

A detailed consideration of the behaviour of the normal E-region shows the existence of minor perturbations from the classical Chapman theory. It is shown that some of these differences can be ascribed to the influence of vertical drift of ionization resulting from the interaction of the earth's magnetic field and the S_q-current system flowing in or near the E-layer. The resulting distortion of the electron density profile of the E-layer is considered, with particular reference to its effect on the values of the parameter f_0E at different latitudes. The diurnal and seasonal changes in the magnitude of the east–west component current are clearly reflected in the variation of f_0E, and an index n, measuring the sensitivity of the E-layer to seasonal changes, shows marked singularities near the latitudes of the S_q-foci. An analysis of conditions on magnetically disturbed days is also given, and it is concluded that at temperate latitude stations there is a depression in fE at times of magnetic disturbance comparable with the magnitude of that associated with the vertical drift effect of the S_q-current system at noon in the summer. Reference is also made to conditions near and within the auroral zone. Consideration of the effect of sporadic E-ionization shows that this does not appear seriously to influence the tabulated values of fE.

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6456 SOME FURTHER ANALYSES OF E-LAYER MEASUREMENTS IN SOUTH AFRICA DURING THE SOLAR ECLIPSE OF 25 DECEMBER 1954. M.W.McElhinny.
J. atmos. terrest. Phys., Vol. 14, No. 3-4, 273-86 (June, 1959).

The E-layer measurements from three stations in South Africa during the solar eclipse of 25 December 1954 have been analysed from three points of view: (a) all the radiation comes from the visible disk, in which case $\alpha' \xi = 1.5 \times 10^{-9}\ cm^3\ sec^{-1}$; (b) 15% of the radiation comes from outside the disk and $\alpha' \xi = 4 \times 10^{-9}\ cm^3\ sec^{-1}$; and (c) the effect of two species of ion with differing recombination coefficients. It is shown that to neglect the effect of a more rapidly recombining species of ion may lead to an overestimate of the effect of the corona or of the limb-brightening.

551.5

6457 A SURVEY OF THE PRESENT KNOWLEDGE OF SPORADIC-E IONIZATION. J.A.Thomas and E.K.Smith.
J. atmos. terrest. Phys., Vol. 13, No. 3-4, 295-314 (Feb., 1959).

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6458 LUNAR TIDES IN THE SPORADIC E-LAYER AT IBADAN. R.W.Wright and N.J.Skinner.
J. atmos. terrest. Phys., Vol. 13, No. 3-4, 217-21 (Feb., 1959).

An analysis of the lunar semi-diurnal tides in fEs and h'Es is made for Ibadan. The results are presented in the form of harmonic dials. Comparisons are made between these results and those of other stations.

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6459 SPIRAL OCCURRENCE OF SPORADIC-E. E.L.Hagg, D.Muldrew and E.Warren.
J. atmos. terrest. Phys., Vol. 14, No. 3-4, 345-7 (June, 1959).

A study of high density sporadic-E ionization at high latidudes has revealed that it is distributed in the form of a spiral similar to that of Störmer's precipitation curve for negative particles (Störmer, 1917). The phenomenon tabulated as sporadic-E may have a variety of causes, among which are thunderstorms, turbulence in a reflected region, ionized meteor trails and the precipitation of particles from the sun. In an attempt to isolate sporadic-E of a single variety, only those events were considered in which vertical incidence reflection of a frequency greater than 5 Mc/s occured. For some stations at which intense sporadic-E is frequent a minimum frequency of 7 Mc/s was chosen. The diurnal variation of the total number of occurrences of fE_s greater than the stated minimum frequency, observed during the month of June for several years, was plotted for each of 14 stations. The process was then repeated for the month of December. The time of day for which sporadic-E was most frequent was determined. Also found was the fraction of the day during which the number of occurrences was greater than 95 per cent of the maximum value. These times and intervals are expressed in local geomagnetic time and are presented, plotted against the geomagnetic latitude of the stations.

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6460 VARIATIONS IN IONOSPHERIC F-REGION CHARACTERISTICS. N.M.Brice.
Austral. J. Phys., Vol. 11, No. 4, 587-91 (Dec., 1959).

Electron density profiles have been computed from ionospheric records taken at Macquerie Island (60° S geomag.). These are probably the first high southern latitude profiles to be calculated and results are given covering midday and midnight hours, summer and winter, for years of sunspot maximum and sunspot minimum activity. H.J.A.Chivers

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6461 TRIPLE-SPLITTING OF THE F-ECHOES. R.Satyanarayana, K.Bakhru and S.R.Khastgir.
J. atmos. terrest. Phys., Vol. 13, No. 3-4, 201-4 (Feb., 1959).

An account is given of the polarization studies made on the triple F-echoes, obtained by employing pulses of waves of frequency, 3 Mc/s. at vertical incidence. The polarization studies revealed that the first component after the ground-pulse was the normal extraordinary component having a right-handed sense of rotation, the second component was the normal ordinary component having a left-handed sense of rotation and the third component was the Z-component having a left-handed sense of rotation. In addition to the coupling process suggested by Eckersley and Rydbeck between the ordinary and extraordinary waves, and operative only in high geomagnetic latitudes, the partial reflection and transmission at the level of ionospheric reflection for the ordinary component have been considered as a plausible process for getting the Z-component. Since the coupling process is not likely to produce a detectable Z-component at low geomagnetic latitudes, the occasional presence of the Z-component at low latitudes has been attributed to the partial reflection and transmission process which may take place at all latitudes. The view that the Z-component really corresponds to the left-handed ordinary component suffering reflection at the level corresponding to $p_0 = p^2 + p.p_H$ has been supported.

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6462 THE INTERMEDIATE LAYER OF STRATIFICATION ($F_{1.5}$) BETWEEN F_1 AND F_2 AT AHMEDABAD. K.M.Kotadia.
Proc. Indian Acad. Sci. A, Vol. 46, No. 5, 349-53 (Nov., 1957).

Details are given of the diurnal variation of the frequency of occurrence, virtual height, and critical frequency of the $F_{1.5}$ layer at Ahmedabad over the period 1954-57, together with some sample ionograms showing the formation of the layer. It appears that it is formed by dynamic causes; after formation, the electron density decays slowly with time at a constant virtual height. G.M.Brown

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6463 GEOMAGNETIC INFLUENCE ON THE F1- AND F2-REGIONS OF THE IONOSPHERE — EFFECT OF SOLAR ACTIVITY. R.G.Rastogi.
J. atmos. terrest. Phys., Vol. 14, No. 1-2, 31-40 (April, 1959).

The paper discusses the geomagnetic influence on the noon critical frequencies of F1 and F2-layers in different seasons and at different stages of solar activity. The F1-layer is found to be affected by the magnetic field only in years of high solar activity. The equatorial depression of noon f_0F2 is, on the other hand, most prominent in years of low solar activity.

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6464 STUDY OF HORIZONTAL DRIFTS IN THE F1- AND F2-REGIONS OF THE IONOSPHERE AT WALTAIR (17°43'N, 83°18'E, MAG. LAT. 9°30'N). B.Ramachandra Rao and E.Bhagiratha Rao.
J. atmos. terrest. Phys., Vol. 14, No. 1-2, 94-106 (April, 1959).

Results of the analysis of drift measurements made at Waltair for the F1- and F2-regions over a period of 2 years are presented. The main features of the diurnal and seasonal variation of drifts in F2-region are given in detail. The general pattern of drift movements for this low latitude station is found to be in phase opposition to those observed at high latitudes, thus confirming F2-region drift theory given by Martyn (1955).

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6465 TWO ANOMALIES IN THE BEHAVIOUR OF THE F2 LAYER OF THE IONOSPHERE.

S.Croom, A.Robbins and J.O.Thomas.
Nature (London), Vol. 184, 2003-4 (Dec. 26, 1959).

A geomagnetic anomaly is observed in the distribution of electron density with magnetic latitude at noon at the equinox. A trough in the distribution is found at the magnetic equator which becomes broader at lower levels in the F region. A diurnal asymmetry is found in the electron density measured at a given height. The density at nearly all latitudes at 09 hours is greater than that at 15 hours for heights above about 200 km, with the opposite effect below 200 km. R.D.Davies

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6466 SOLAR TIDAL EFFECTS IN THE F_2-REGION OF IONOSPHERE OVER DELHI. C.S.Raghavendra Rao.
Indian J. Phys., Vol. 31, No. 10, 516-25 (Oct., 1957).

Ionospheric data collected at Delhi over the period 1946-1955 have been analysed for these effects. The method developed by Martyn and extended by Mitra (Abstr. 3141 of 1951) has been utilized for the purpose. The magnitude and phase of the drift velocities for the different seasons and the relative importance of the drift velocity are determined. While the seasonal velocities have been found to be of the order of 20, 18 and 33 km/hr for summer, winter and equinox months, the ratio of the seasonal to semi-diurnal velocity has been obtained to be of the order of 1.5. This agrees well with the result obtained by Martyn. The observed variations in N_m have been explained in terms of the phases of the drift velocities. The values of the attachment coefficient for the three seasons of the year have also been determined taking the tidal effects into consideration. These are found to agree fairly well with the recent results of Ratcliffe et al. (See Abstr. 7869-70 of 1956).

551.5

6467 SOME MEASUREMENTS OF HORIZONTAL MOVEMENTS IN REGION-F2 USING WIDELY SPACED OBSERVING STATIONS. L.Thomas.
J. atmos. terrest. Phys., Vol. 14, No. 1-2, 123-37 (April, 1959).

The results of a study of horizontal movements in region-F2 using a system of stations spaced some 200 km apart are described. Vertical incidence recordings were used to study corresponding fluctuations at the three stations in the critical frequency and in the equivalent height of reflection at a fixed frequency. The measured velocities ranged from 40 to 280 m/sec and the direction of travel of the perturbations was mainly towards the South-east. A limited number of simultaneous observations at a station some 650 km north of the main group showed that these large-scale irregularities travel such distances with little change in direction but there is clear evidence for larger velocities at more northerly latitudes. A comparison of the velocity magnitudes deduced from the two parameters (critical frequency and equivalent height) indicates a positive height-gradient of velocity of the order of 1 m/sec per km within region-F2. The results also suggest that the height gradient is larger in winter than in summer and larger near the lower edge of the layer than at the peak. Correlation, over both long and short periods, was observed between velocity magnitude and the degree of magnetic activity.

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6468 AURORAL ACTIVITY AT LOW LATITUDES. D.Barbier.
Ann. Geophys., Vol. 14, No. 3, 334-55 (July-Sept., 1958). In French.

A comprehensive survey of observations made with three different types of photoelectric photometers equipped with interference filters at stations in Europe (Haute Provence) and Africa (Tamanrasset). Details of 30 aurorae observed at the former station between 7 March 1956, and 3 October 1957 are tabulated. The characteristics of the normal type of low-latitude activity in relation to the emission of the red O I doublet at 6300 A are discussed. A detailed account is also given of an anomalous display observed visually at Haute Provence on 28 January 1957 during a period of low geomagnetic activity. On this occasion the distribution of spectral intensity was totally unlike anything previously recorded.

D.R.Barber

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6469 ON THE AURORA OF 19 AUGUST 1950, PHOTOGRAPHED FROM GREECE. W.N.Abbott and S.Chapman.
J. atmos. terrest. Phys., Vol. 14, No. 1-2, 111-22 (April, 1959).

Further details are given concerning an auroral photograph already reproduced and discussed (Abbott, 1951). The association between the occurrence of aurorae in low latitudes and the 3 hr geomagnetic disturbance index K_p is considered. The aurora was reported from places over a wide area (Europe, the Atlantic and North America); its reported appearances ranged from 18 August at 2130 hours to 19 August, 0530 hours UT (at Nantucket); and from New Zealand it was seen after sunset, from about 0730 UT on 19 August.

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6470 PHOTOMETRIC OBSERVATIONS OF SUBVISUAL RED AURORAL ARCS AT MIDDLE LATITUDES. R.A.Duncan.
Austral. J. Phys., Vol. 12, No. 2, 197-8 (June, 1959).

At Camden, N.S.W. subvisual auroral arcs were observed photoelectrically at 6300 A on nights following the two bright auroral displays of July 8-9, and September 4-5, 1958. During both these observations the 5577 A airglow emission showed no anomaly. The arcs were centred within 1 or 2 degrees of geomagnetic South at an altitude of about 25 degrees, and in each instance they persisted for several hours. The intensity of the red emission decreased steadily with time, in contrast with the rapid and irregular fluctuations normally observed in bright displays. These red arcs occurring in mid-latitudes at times of only moderate geomagnetic disturbance ($K \leq 5$) are comparatively rare phenomena since only four have been reported from S.Norway in 40 years. D.R.Barber

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6471 AN ANALYSIS OF A SPECTROGRAM OF THE RED AURORA OF FEBRUARY 10/11, 1958, IN THE WAVELENGTH RANGE 7300-8700 A. A.V.Jones.
Canad. J. Phys., Vol. 38, No. 3, 453-7 (March, 1960).

A high-dispersion photographic infrared spectrum covering the 7300-8700 A region was obtained from the great red aurora of February 10/11, 1958. This spectrum shows the λλ7774 and 8446 O I lines to have been enhanced at least five times relative to normal aurora. The most striking feature of the spectrum was the appearance with high intensity of the forbidden $^2D-^2P$ multiplet of O II. The measured wavelengths and relative intensities of the features of the spectrum are listed.

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6472 ROTATIONAL AND VIBRATIONAL INTENSITY DISTRIBUTION OF THE FIRST NEGATIVE N_2^+ BANDS IN SUNLIT AURORAL RAYS. A.V.Jones and D.M.Hunten.
Canad. J. Phys., Vol. 38, No. 3, 456-76 (March, 1960).

Spectra of sunlit auroral rays were obtained from Saskatoon during the auroras of September 3-4 and 4-5, 1958. The resolution of these spectra was sufficiently high to enable measurements to be made of the relative intensities of the lines of the 0-0 first negative N_2^+ band as well as the relative intensities of bands of the $\Delta v = -1$ sequence of this system. An analysis of the rotational line intensities shows they are consistent with an excitation process in which N_2^+ ions in thermal equilibrium with the atmosphere at 2200°K fluoresce under the influence of solar radiation. The vibrational intensity distribution also is consistent with a fluorescent excitation from a state of thermal equilibrium at about 2050°K. It is shown that the results are not consistent with a fluorescent excitation process in which the rotational and vibrational degrees of freedom of the N_2^+ ions come into radiative equilibrium with the solar radiation. Earlier conclusions that radiative equilibrium did hold for vibration are shown to be in error as a result of the high rotational temperature and the low dispersion used. It is concluded that the destruction of N_2^+ ions as a result of dissociative recombination proceeds sufficiently fast to prevent any significant approach to radiative equilibrium. This investigation provides a strong indication that the kinetic temperature of a sunlit auroral ray (perhaps in the 400-500 km region) is in the neighbourhood of 2000°K. This may be somewhat higher than the temperature of the normal atmosphere at this height.

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6473 DAWN ENHANCEMENT OF AURORAL N_2^+ EMISSION. E.A.Lytle and D.M.Hunten.
Canad. J. Phys., Vol. 38, No. 3, 477-81 (March, 1960).

The 0–0 band at 3914 A was observed once per minute with a scanning spectrometer as sunlight illuminated the upper atmosphere on the morning of September 5, 1958. It is reasonable to assume that the density of N_2^+ ions was maintained constant during this time, and that the observed rise of intensity was due to resonance scattering of sunlight. The ions were found to be distributed between 180 and 320 km with peak at 250; density here was 12×10^4 ions/cm^3. There was some evidence for another layer at 120 km. Rotational temperatures measured while the main layer was fully illuminated agreed well and gave an average of 1060 ± 100° K.

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6474 OBSERVATIONS OF MEINEL N_2^+ BANDS NEAR 1.5 μ IN THE AURORAL SPECTRUM.
A.W.Harrison and A.Vallance Jones.
J. atmos. terrest. Phys., Vol. 13, No. 3-4, 291-4 (Feb., 1959).

The 0,1 and 1,2 Meinel bands have been observed in the auroral spectrum at 1.46 μ and 1.53 μ. The maximum observed absolute brightnesses of these bands were found to be 148 and 426 kilorayleighs (kR) respectively. The brightness of the 1,2 band appears to be anomalously high and this may be a result of preferential excitation by collision with $O^+(^2D)$ ions. A feature of high but fluctuating brightness at 1.59 μ agrees in wavelength with the 2,3 N_2^+ band but appears to be somewhat brighter than is consistent with this identification. It is possible that the latter emission may arise from the excitation in aurora of the 0,1 $^1\Delta_g - {}^3\Sigma_g^- O_2$ band. An unidentified emission has been observed at 1.61 μ on some of the auroral spectra obtained.

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6475 ABSOLUTE PHOTOMETRY OF THE AURORA. I. THE IONIZED MOLECULAR NITROGEN EMISSION AND THE OXYGEN GREEN LINE IN THE DARK ATMOSPHERE. M.H.Rees.
J. atmos. terrest. Phys., Vol. 14, No. 3-4, 325-37 (June, 1959).

A low latitude aurora was measured photometrically. Three prominent emission features, λ3914 band of 1.N.G. N_2^+, λ5577 of O I and λ6300-6364 of O I, were isolated with narrow pass band filters and recorded continuously throughout the night in the meridian sweep. Absolute calibration was carried out, and corrections for the scattered light and atmospheric extinction were made. The absolute emission intensity for λ3914 and λ5577 is given at a selected zenith distance. The ratio of instantaneous intensities I(O)5577 to I(O)3914 was found to be essentially constant over an intensity range of three powers of ten and to be independent of the type of auroral form. The intensities and correlations obtained are consistent with the following excitation mechanisms. In the dark atmosphere the N_2^+ is excited from ionizing collisions of incoming particles with atmospheric N_2. It is concluded that the O I λ5577 line results from secondary electrons, arising from the primary ionization process above, colliding inelastically with oxygen atoms.

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6476 ABSOLUTE PHOTOMETRY OF THE AURORA. II. MOLECULAR NITROGEN EMISSION IN THE SUNLIT ATMOSPHERE. M.H.Rees.
J. atmos. terrest. Phys., Vol. 14, No. 34, 338-44 (June, 1959).

The absolute emission intensity of a sunlit aurora was determined for the 1.N.G. λ3914 band of N_2^+ by subtracting the emission intensity originating in the dark atmosphere from the total measured intensity. The method is based on the constancy of the ratio of emission intensity of the oxygen green line O I λ5577 to the λ3914 emission in the dark atmosphere. The ion density of N_2^+ is computed as a function of height from the emission rate per unit volume.

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6477 THE TEMPERATURE IN THE ATMOSPHERIC REGION EMITTING THE NIGHTGLOW O I 5577 LINE AND IN REGIONS ABOVE FAINT AURORAL ARCS. E.B.Atmstrong.
J. atmos. terrest. Phys., Vol. 13, No. 3-4, 205-16 (Feb., 1959).

A number of observations of nightglow and auroral temperatures made with a photoelectric scanning Fabry–Perot interferometer are presented and discussed. The results suggest that the temperature of the region emitting the nightglow 5577A radiation lies within the range 180° to 220° K, with a most likely value of 190° K. Temperatures measured above faint auroral arcs ranged from 310° to 540° K. The published temperatures of the upper atmosphere obtained spectroscopically are surveyed.

551.5 : 537.52

AURORAL AFTERGLOW. LABORATORY STUDY. See Abstr. 5293

551.5 : 621.396.969

6478 THE ASSOCIATION OF VISIBLE AURORAL FORMS WITH RADAR ECHOES. G.F.Lyon.
Canad. J. Phys., Vol. 38, No. 3, 385-9 (March, 1960).

A peak in 48.2 Mc/s echo occurence is observed at Saskatoon corresponding in time to the period of breakup of quiet arcs into active rayed structures. This is also the time of most frequent occurence of characteristic "curl" forms in the aurora. If, as Gartlein suggests, the "curl" forms are formed by instabilities in a sheet beam then the primary particles are positively charged.

551.5 : 621.396.969

6479 AN ANALYSIS OF SOME STATISTICAL PROPERTIES OF AURORAL RADAR REFLECTIONS AND THEIR RELATIONSHIPS TO THE DETECTION CAPABILITIES OF THE RADAR. A.G.McNamara.
Canad. J. Phys., Vol. 38, No. 3, 425-38 (March, 1960).

A statistical model of auroral echo occurrence has been made from an analysis of observations at 48.5 Mc/s obtained over a number of years of continuous operation. The probability density distribution of auroral target cross-sections (σ) has been examined experimentally, and the resulting curve fitted by simple mathematical relations. Both an inverse power law and an exponential law have been derived, of the forms

$$p(\sigma)d\sigma = k\sigma^{-1.67}d\sigma$$

and

$$p(\sigma)d\sigma = \frac{1}{\sigma m} e^{-\sigma/\sigma m}d\sigma.$$

These models have been interpreted in terms of distributed and localized targets, and used to analyse the echo occurrence indices and the effect which variation of radar parameters will have upon them. Both forms of the target law are useful although it is considered that the exponential form yields better agreement with observations over a wider range of the variables.

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6480 A BISTATIC RADIO INVESTIGATION OF AURORAL IONIZATION. C.Collins and P.A.Forsyth.
J. atmos. terrest. Phys., Vol. 13, No. 3-4, 315-45 (Feb., 1959).

The scattering of radio waves in the upper atmosphere during auroral disturbances has been studied by means of a number of radio systems in which each transmitter was separated from its associated receiver by a distance of about 1000 km. Some twenty of these systems were used in a network covering a large area in Canada. The frequencies were in the range 30-50 Mc/s. At least four different kinds of auroral events are distinguishable. Of these, two appear to be associated separately with different phases of visible aurora, the third with a later stage in the auroral process which is not observed visually, and a fourth with the recurrent daytime absorption which often precedes an auroral disturbance. The term "radio-aurora", which applies to all of the events, is used to avoid confusion with that part of the auroral process which is observable visually. In these four events, evidence is found for three separate scattering mechanisms, each of which has been proposed previously as the principal source of radar echoes from aurora.

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6481 DETERMINATION OF THE ANGLE OF ARRIVAL OF AURORAL ECHOES. L.Harang and J.Trötim.
J. atmos. terrest. Phys., Vol. 14, No. 1-2, 107-10 (April, 1959).

The angle of arrival, θ, of auroral echoes is measured by an interference method. The variation of θ with echo range R is demonstrated. θ varies from 15° to 6.5° when the range increases from 400 to 730 km. The height of the reflection area must lie at 100-120 km.

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6482 THE EMISSION OF THE H AND K LINES OF IONIZED CALCIUM IN THE SPECTRUM OF THE TWILIGHT SKY. M.Dufay.
Ann. Geophys., Vol. 14, No. 3, 391 (July-Sept., 1958). In French.

During tests of an F/1 grating spectrograph (dispersion 70 A/mm) intended for I.G.Y. research in Antarctica, the presence of the H and K Ca^+ emission at twilight (Abstr. 961 of 1957) was confirmed at Haute Provence, France in July 1956, and again in July 1957 at Adelie Land, Antarctica. There is some indication that the line emission is most noticeable (in both hemispheres) on dates closely following intense meteor activity, thus pointing to a possible origin of the Ca atoms. D.R.Barber

551.5 : 539.19

ULTRAVIOLET SPECTRUM OF THE OXYGEN AFTERGLOW AND THE NIGHT AIRGLOW. See Abstr. 5954

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6483 ON THE MEASUREMENT OF SKYLIGHT POLARIZATION. M.Richartz.
J. Opt. Soc. Amer., Vol. 50, No. 3, 302-3 (March, 1960).

A simple method is described by which a Babinet compensator (combined with an analyser to form a polariscope) has been employed to measure the plane of vibration, and, where it occurs, the ellipticity of sky light. R.W.Nicholls

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6484 POLARIZATION OF LIGHT FROM NOCTILUCENT CLOUDS. G.Witt.
Nature (London), Vol. 184, 1618-19 (Nov. 21, 1959).

551.5 : 621.317.75

6485 AUTOMATIC RECORDER OF THE WAVEFORMS OF ATMOSPHERICS. B.A.P.Tantry.
Indian J. Phys., Vol. 32, No. 6, 267-75 (June, 1958).

An automatic atmospherics recorder was constructed for recording the electric field-changes during various lightning discharges. It consists of several suitable units which were designed for obtaining complete, accurate and non-overlapping oscillograms with minimum waste of recording film. Details of the component units and the various associated circuits are described.

551.5 : 550.3

CHARACTERISTIC INTERVALS OF OSCILLATIONS WITH DECREMENT PERIOD OF 10-1 SEC IN THE ELECTROMAGNETIC FIELD OF THE EARTH, AND THEIR RELATIONSHIP TO PHENOMENA IN THE UPPER ATMOSPHERE. See Abstr. 6436.

551.5

6486 INTERPRETATION OF SMOOTH TYPE ATMOSPHERIC WAVEFORMS. F.Hepburn.
J. atmos. terrest. Phys., Vol. 14, No. 3-4, 262-72 (June, 1959).

Following a brief survey of the conflicting opinions in this field and general remarks on pulse reflection and waveguide interpretations of atmospheric waveforms, the analyses of smooth type waveforms of varying degrees of irregularity are considered. Since observation suggests such irregularities are a source phenomenon, the implications of various discharge currents in the lightning channel are discussed in terms of waveguide propagation in the first-order mode and are seen to explain regular and pseudo regular waveforms. The simple reflection theory is also extended to more complicated source conditions to give analogous conclusions. Obviously irregular waveforms are tentatively ascribed to discharges of pulsating character. Amplitude analysis of the waveform oscillation is shown to give the waveform spectrum very simply so that observations of a statistical nature can yield both the average spectrum at the source and the relative attenuation coefficients for the respective frequencies which are propagated. A review of previous work in the light of the present paper is thought to resolve the apparent discrepancies.

551.5 : 523.16

MEASUREMENT OF COSMIC NOISE AT LOW FREQUENCIES ABOVE THE IONOSPHERE. See Abstr. 4847

551.5

6487 TIME RESIDENCE OF RADIOACTIVE DEBRIS IN THE STRATOSPHERE. J.Ambrosen.
Nature (London), Vol. 185, 301-2 (Jan. 30, 1960).

The ratio of the Sr^{89} to Sr^{90} components of radioactive fallout was measured, over a period of ten months, at five stations situated between latitudes 55°N to 67°N. Measurements indicate that radioactive dust due to nuclear explosion, whilst affecting the Northern posts almost immediately, reached the Southern stations two months later. Composition of the fallout appeared to be very uniform at all stations, the results indicating that 40-50% of the fallout in the Spring of 1959 was due to tests held in the Northern Hemisphere in the Autumn of 1958 and mainly of stratospheric origin.

R.H.Thomas

551.5

6488 ESTIMATION OF ATMOSPHERIC ACTIVITY USING AN ELECTROSTATIC FILTER. W.Kern.
Nukleonik, Vol. 1, No. 8, 314-19 (Oct., 1959). In German.

Describes the measurements of atmospheric radioactivity by means of an electrostatic precipitation filter. The mean size of active particles remaining in the atmosphere for any appreciable length of time lies between 0.5 and 3 μ. Since the distribution of active material throughout the air is extremely non-uniform, an estimation of the contamination must be carried out on large volumes of air. Autoradiographic methods can be used to register particles with activities above 10^{-13} but the activity of the majority of aged fragments lies in the range of 10^{-11} to 10^{-13} c. Strongly active particles ($\sim 10^{-9}$ c) are sometimes found.

S.J.St-Lorant

BIOPHYSICS · PHYSIOLOGICAL PHYSICS

576.2

6489 APPARATUS FOR APPLYING LIQUIDS IN SMALL DROPLETS TO ANIMALS.
E.E.Buckholz and M.K.McPhail.
Rev. sci. Instrum., Vol. 31, No. 2, 132-6 (Feb., 1960).

A precision apparatus for applying liquid in uniform droplets to test surfaces is described. The mean diameter of the droplets can be varied from 0.045 to 0.450 mm.

577.1

6490 ELECTRON TRANSFER IN BIOLOGICAL SYSTEMS. B.Chance.
Proc. Inst. Radio Engrs, Vol. 47, No. 11, 1821-40 (Nov., 1959).

The direct approach to a study of the dynamics of the essential intermediates in life processes is afforded by sensitive optical techniques that accurately measure and record the absorbancy of the iron proteins (cytochromes) in living cells, tissues, and particles derived therefrom. This paper outlines the nature of physical phenomena measurable in the biological systems and emphasizes current thinking on the nature of electron transfer between the proteins which involves oxidation and reduction of their iron-containing active centres with the simultaneous conservation of energy required for driving essential biological processes. The methods for these measurements are reviewed and spectrophotometric techniques at room and liquid nitrogen temperatures, and new developments such as microspectrophotometry of the cytochromes in portions of the living cell are emphasized. Data evaluation and representation of electron transfer processes and metabolic control sequences by analogue and digital computers are described and particular reference is made to the operation of metabolic controls in ascites tumor cells.

577.1

6491 ALTERNATING CURRENT SPECTROSCOPY OF BIOLOGICAL SUBSTANCES. H.P.Schwan.
Proc. Inst. Radio Engrs, Vol. 47, No. 11, 1841-62 (Nov., 1959).

The electrical properties of live matter are analysed. The article first summarizes general principles which pertain to the frequency dependnece of the electrical properties of any type of matter. It then states the particular mechanism which, at various parts of the total frequency spectrum, are predominantly responsible for observed data. They include time-dependent interface polarization, accumulation of charges due to inhomogeneous structure and orientation of polar molecules. The electrical properties of water and electrolytes, of protein suspensions, of subcellular and cellular structures are outlined in terms of previously mentioned mechanism. This, in turn, permits synthesis of the experimentally observed dielectric parameters of tissues. The treatment encompasses the total range of frequencies, from 1 c/s to 100 000 Mc/s. The article outlines the application of the data and pertinent impedance techniques to a variety of basic and applied problems in biology and medicine.

577.3 : 621.317.49

6492 A MAGNETIC FLOWMETER FOR RECORDING CARDIAC OUTPUT.
H.W.Shirer, R.B.Shackelford and K.E.Jochim.
Proc. Inst. Radio Engrs, Vol. 47, No. 11, 1901-12 (Nov., 1959).

The cardiac output flow pulse (less coronary flow) can be recorded with a magnetic flowmeter applied to the unopened ascending aorta, provided: (1) the extremely large e.k.g. potentials in this region are rejected; (2) the flowmeter is phase-sensitive; and (3) the over-all instrument response is uniform from zero to 100 c/s. These requirements are fulfilled by the instrument described through the use of the square-wave method recently introduced by Denison (Abstr. 137 of 1957) and by using a high switching-frequency (480 c/s), an input high-pass filter, and a double-balanced demodulator. Two output channels of suitable response provide for simultaneous recording of instantaneous and mean flow. Each pickup sleeve is calibrated in vitro in terms of microvolts per flow rate. An electrical series calibrator provides the operational calibration. Past methods are reviewed and circuit details and design considerations are discussed.

577.3

6493 ABSORPTION OF ULTRASOUND BY TISSUES AND BIOLOGICAL MATTER. H.P.Schwan.

Proc. Inst. Radio Engrs, Vol. 47, No. 11, 1959-62 (Nov., 1959).

General principles which determine the frequency dependence of both absorption and velocity of ultrasound in matter are outlined and applied to cell suspensions and tissues. The mechanisms which are responsible in the biological case for the experimentally observed frequency dependence of ultrasonic properties are described. They relate predominantly to macromolecular components. Finally, the relationships which pertain to the propagation of ultrasound in heterogeneous tissue complexes are discussed, and consequences for the medical application as a therapeutic tool are considered.

Hearing . Speech

612.7

6494 PHONETIC RECOGNITION AND ITS MEASUREMENT. J.C.Lafon.

Ann. Telecomm., Vol. 15, No. 1-2, 27-37 (Jan.-Feb., 1960). In French.

Studies bearing on the main field of phonetic research are discussed, particular attention being paid to those involving the French language. It is emphasized that phonetics is now a comprehensive subject touching on the fields of acoustics, psychology, physiology and pathology. M.L.Gayford

612.7

6495 THE SPEECH NOISE AND ITS SPECTRUM. T.H.Tarnóczy.

Acta phys. Hungar., Vol. 7, No. 1, 87-105 (1957).

By recording on one magnetic tape the simultaneous utterances of several talkers through several channels, a noise is obtained that is constant in time and continuous in frequency, and renders the average spectral components of speech more faithfully than other methods. Such speech noises are open to analysis, and their spectra can thus be determined. The advantages of the method are: (1) the integration needed for determining the long-time spectrum can be reduced to a few seconds; (2) the noise can be treated as a statistical noise constant in time; (3) the noise does not contain any line spectrum elements; (4) it improves the signal-to-noise ratio, even under a normal force of utterance. It is shown that the speech spectrum of a certain language may be looked upon as being representative of the language in question. Long-time speech spectra obtained by this method are used to compute the average loudness level of a single person. The method can be used to find the characteristic spectra of certain speech sounds and of individual pronunciation.

612.7

6496 RESEARCHES ON THE SINGING VOICE. G.G.Sacerdote.

Acustica, Vol. 7, No. 2, 61-8 (1957).

Electroacoustical analysis methods were employed to study some of the parameters characteristic of the singing voice. Vibrato was studied in the case of an emission accopanied by the hearing of a given sound, in order to find out the effect of synchronization. The singing of a choir was examined from a statistical point of view, by determining the autocorrelation function.

612.7

6497 SOME ACOUSTIC CORRELATES OF WORD STRESS IN AMERICAN ENGLISH. P.Lieberman.

J. Acoust. Soc. Amer., Vol. 32, No. 4, 451-4 (April, 1960).

Twenty-five English noun–verb pairs, differing principally in their stress patterns, were recorded by 16 native speakers of American English. The fundamental frequency, relative amplitude, duration, and integral of the amplitude with respect to time of the stressed and unstressed syllables were measured and related to the aurally perceptible stress patterns. The relative value of these factors as cues to such patterns varied with different speakers, but it was found that certain "trading effects" offset a lack of differentiation in one acoustic dimension by changes, coherent with the perceptual stress pattern, in another dimension. A simple binary automatic stress recognition programme, based on the redundancies inherent in the acoustic correlates and trading effects, was then devised. The stress judgments made with this programme agreed with the perceived patterns 99.2%.

612.8

6498 THE ACOUSTICAL IMPEDANCE PRESENTED BY SOME HUMAN EARS TO HEARING-AID EARPHONES OF THE INSERT TYPE. J.Y.Morton and R.A.Jones.

Acustica, Vol. 6, No. 4, 339-45 (1956).

The acoustical impedance presented by human ears to insert-type hearing-aid earphones over the frequency range 220 c/s to 4000 c/s has been measured with a complete seal between the ear-mould and the ear-canal. The acoustical impedance of the ear at a position in the ear-canal approximately 1.6 cm from the ear-drum has been determined and the impedance at the drum estimated. All 19 ears measured were of persons with normal hearing. A continuously variable acoustical impedance developed for this investigation is described.

612.8

6499 ELEMENTARY PRINCIPLES OF THE DETERMINATION OF THE INFORMATION CAPACITY OF THE EAR. E.Zwicker.

Acustica, Vol. 6, No. 4, 365-81 (1956). In German.

From the audible amplitude and frequency modulation levels, both of pure tones and of sections of white noise, the elements of the sound changes in the hearing surfaces are combined. By means of a model which has as a basis the perception of a change in sound intensity of 1 dB of a frequency group with the mean time constant of 20 msec, the audibility of the amplitude modulation, the frequency modulation and that of phase differences, as well as the masking is clarified. The maximum perceptible information is estimated and its application to syllable-intelligibility illustrated.

612.8

6500 IRREGULAR DIFFRACTION EFFECTS OF SUBJECTS IN A FREE FIELD. J.Y.Morton.

Acustica, Vol. 7, No. 1, 59 (1957).

Reports that small movements of the arms of a subject produced sound pressure changes in the ear canal, and that the position of the body may effect the loudness experienced by a subject. H.D.Parbrook

612.8

6501 RECENT TESTS ON THE ACTION OF NOISES ON THE ENDOCRINIC SYSTEM. J.D.Romani and P.Bugard.

Acustica, Vol. 7, No. 2, 91-3 (1957). In French.

Certain sensitive strains of guinea-pigs submitted to sounds (100 to 125 dB, 15 to 25 min) often show lethal effects after 12 to 48 hr. There is evidence of a congestion of the antehypophysis with a degranulation of α-cells, an inhibition of the thyroid, and a decrease of the lipids of the adrenal cortex. This alarm reaction at the stage of exhaustion contrasts with the well-compensated endocrinic reaction of dogs and rabbits submitted to very intense sounds (130 to 140 dB) during longer exposure times (1 to 4 hr).

612.8

6502 ACTION OF NOISES ON NEURO-MUSCULAR EXCITABILITY. P.Bugard and J.D.Romani.

Acustica, Vol. 7, No. 2, 93-5 (1957). In French.

Sounds (100 to 125 dB) lower the motive threshold of the sciatic nerve in guinea-pigs. This increase of the excitability seems due to a central action. General anaesthesia with ether does not affect the excitability of the sciatic nerve, and protects the animals against over-excitability due to noise. Experiments with sounds require precautions against the basic environmental level of noise, and careful manipulations of the animals in order to avoid a prior induced hyperexcitability of the animals.

612.8

6503 ON THE THRESHOLD OF HEARING FOR DIFFERENT SOUND EVENTS. E.Zwicker.

Frequenz, Vol. 13, No. 8, 238-42 (Aug., 1959). In German.

Describes an investigation of the threshold of hearing in the following cases: (1) sinusoidal tones in the range of frequency 5 to 80 c/s; (2) octave-band sounds as a function of mean band frequency and (3) impulses as a function of impulse-duration. In the first two cases the experimental curves of intensity versus frequency show a minimum near 20 c/s. A.B.Wood

612.8

6504 THE DIRECTIONAL CHARACTERISTIC OF ONE EAR IN HUMAN HEARING. G.Jahn and S.Vogelsang.

Hochfrequenztech. u. ElektAkust., Vol. 68, No. 2, 50-6 (July, 1959). In German.

Describes an investigation of the directional characteristics of

the human ear for four frequency bands ($\frac{1}{3}$ octave) between 1 and 8 kc/s. Use was made of a probe-microphone to measure objectively the sound intensity level at the eardrum of the test subject, while the sound source was moved around the head at constant range through $\pm 180^{\circ}$. The results of the measurements on different persons at mean frequencies below 5 kc/s agree reasonably well within ±2 dB. At higher frequencies however individual variations of 6 dB or more, due to different shapes of head, are observed. Reference is made to a paper by Sivian and White (Abstr. 3722 of 1933).

A.B.Wood

612.8

6505 DETERMINATION OF ABSOLUTE-INTENSITY THRESHOLDS AND FREQUENCY-DIFFERENCE THRESHOLDS IN CATS. N.Elliott, L.Stein and M.J.Harrison.
J. Acoust. Soc. Amer., Vol. 32, No. 3, 380-4 (March, 1960).

While the cat's basilar membrane is only two-thirds the length of the human, its auditory-frequency range is at least three times as great. Behaviourally defined absolute-intensity and differential-frequency thresholds were determined for the cat and are compared with those of humans. The cat's absolute thresholds lie well below those of humans over nearly all of the frequencies the two species respond to in common. The cat's differential thresholds, however, are larger at all frequencies. But because of the cat's larger frequency range, the total number of discriminable steps appear to be about equal. Counts of ganglion cells and hair cells for the ear are reported and compared with counts for humans. The greater density of the cat's ganglion cells may explain its lower thresholds, but there appears to be no direct relation between ganglion-cell density and frequency discrimination. The lower density of hair cells for the cat, coupled with its shorter basilar membrane, may account for its poor frequency discrimination.

612.8

6506 STEREOPHONIC AND QUASI-STEREOPHONIC REPRODUCTION. J.P.A.Lochner and W.De V.Keet.
J. Acoust. Soc. Amer., Vol. 32, No. 3, 393-401 (March, 1960).

In stereophonic reproduction there are two qualities which distinguish it from single-channel reproduction. The first of these is a directional separation of sound sources and the second, and probably the most important characteristic of stereophonic reproduction, is the sensation of "depth" and "presence" that it creates. It is well known that the relative amplitudes and times of arrival at an observer's ears of first sounds received from the loudspeakers determine the apparent direction of the sound sources in a stereophonic system, and it is often assumed that this is also responsible for the perception of "depth" and "presence" normally linked with this system. It appears, however, that only the former quality, directional separation, is based on the relative amplitudes and times of arrival of first sounds and that the latter quality, called "ambience," is entirely on account of delayed reflections or echoes recorded and reproduced through the separate channels of the stereophonic system. Single recording-channel quasi-stereophonic systems, in which these echoes were brought out as in the stereophonic system, but which could not give separation of sources, were subjectively compared with true stereophonic systems and the results are presented in this paper.

612.8

6507 PROTECTIVE EFFECT OF THE ACOUSTIC REFLEX FOR IMPULSIVE NOISES. J.L.Fletcher and A.J.Riopelle.
J. Acoust. Soc. Amer., Vol. 32, No. 3, 401-4 (March, 1960).

Twenty-four male subjects were trained in the use of the Bekesy audiometer. Then they were exposed to 100 rounds of machine-gun fire, both with and without a pre-exposure to a 1000 c/s tone for activating the acoustic reflex. Pre- and post-firing audiograms, taken under both conditions, were compared to determine temporary thresholds shifts. Shifts obtained with the reflex-activating tone were found to be significantly smaller than those obtained in its absence.

612.8

6508 "EXPLORING TONES" : DISCREDITED BY A SIREN EXPERIMENT. M.F.Meyer.
J. Acoust. Soc. Amer., Vol. 32, No. 3, 405-6 (March, 1960).

At least four times in the history of acoustics the assertion has appeared in print that the existence "somewhere" (in the air or in the middle ear or in neuro-chemistry) of a (not consciously heard) harmonic can be tested by the audibility of beats of an exploring tone, where an exploring tone is defined as a physical tone of nearly the same frequency as the frequency of the "hunted" tone. This assertion is shown to be baseless and purely fictional.

612.8

6509 ANALYSIS OF INCORRECT RESPONSES TO AN UNKNOWN MESSAGE SET.
I.Pollack, H.Rubenstein and L.Decker.
J. Acoust. Soc. Amer., Vol. 32, No. 4, 454-7 (April, 1960).

The incorrect response of listeners to an unknown message set of 144 words, presented in noise, were analysed. Attention was focused upon the word-frequency distribution of the incorrect responses and upon the proportion of the incorrect responses that were nonsense responses. Both measures were affected by the speech-to-noise ratio, but were approximately independent of the stimulus-word frequency.

612.8

6510 RELATION BETWEEN LOUDNESS AND DURATION OF TONAL PULSES. II. RESPONSE OF NORMAL EARS TO SOUNDS WITH NOISE SENSATION. F.Miskolczy-Fodor.
J. Acoust. Soc. Amer., Vol. 32, No. 4, 482-6 (April, 1960).

For Pt I see Abstr. 10479 of 1959. Investigations of threshold change as a function of various durations of a tonal pulse indicate a reduced rate of threshold change and a shortened time threshold for noise as compared with normal values for a 1000 c/s pure tone. This result is explained by the increased loudness level of low noise intensities, and supports the concept of a direct relationship between loudness and time threshold. However, this relationship is modified as the frequency distribution of the test tone changes noticeably with shortening of pulse duration. For tonal pulses shorter than click pitch, the threshold change shows an increased rate in a frequency dependent range of duration. This may be due to an increased energy spread along the frequency axis. However, a further decrease of tonal pulse duration produces a smaller rate of threshold change than has been found for any other duration ranges of pure tones between 250 and 4000 c/s; this rate of threshold change is similar to that found for noise. The perceived changes, caused by the energy spread, may limit the direct relationship between time threshold and loudness in the case of very short signal durations.

612.8

6511 RELATION BETWEEN LOUDNESS AND DURATION OF TONAL PULSES. III. RESPONSE IN CASES OF ABNORMAL LOUDNESS FUNCTION. F.Miskolczy-Fodor.
J. Acoust. Soc. Amer., Vol. 32, No. 4, 486-92 (April, 1960).

The previously determined relation (preceding abstract) between time-threshold and loudness is investigated in cases of abnormal loudness response. General principles concerning the nature of the altered function are established in pathologic cases with complete recruitment by time-threshold measurement and by binaural loudness matching with the following results: (1) at a constant level above threshold, the hearing loss in decibels is related to the logarithm of the pathologic degree of loudness increment, as determined by L/I values; (2) for a given hearing loss, the L/I value of the loudness-increment degree decreases linearly with the logarithmic increase of the level above threshold; (3) the graphic results of time-threshold determination appear directly continuous with those of loudness matching. Present findings extend the validity of previously determined loudness-duration relations to abnormal loudness responses. Experimentally induced abnormal loudness response under conditions of masking confirms the results. In cases of mixed impairment, with incomplete recruitment, the receptive component of hearing loss can be determined in decibels from the measured degree of loudness increment. The results of such determinations are similar to those obtained by bone-conduction measurements. The significance of time-threshold determinations and the limitations in their practical applicability for loudness measurements are discussed.

612.8

6512 DIMENSIONAL ANALYSIS OF COCHLEAR MODELS. J.Tonndorf.
J. Acoust. Soc. Amer., Vol. 32, No. 4, 493-7 (April, 1960).

It is generally known that events occurring in different systems which, although differing in size, are physically similar can be quantitatively related to each other.by Dimensional Analysis. The significance for Auditory Theory of various phenomena observed previously in cochlear models would be considerably increased if a dimensional analysis were performed of these models. This paper represents an attempt at such an analysis. In the amplitude domain, its results

suggest a close relation between the levels at which Bekesy's eddies first become visible in the model and at which harmonic distortion first becomes audible in the human ear. In a previous paper on cochlear models, evidence had been given that the appearance of Bekesey's eddies represents the onset of harmonic distortion in the model. The present analysis has strengthened the validity of this concept.

612.8

6513 RECOVERY FROM HIGH VALUES OF TEMPORARY THRESHOLD SHIFT. W.D.Ward.

J. Acoust. Soc. Amer., Vol. 32, No. 4, 497-500 (April, 1960).

Twelve normal observers were exposed to noise that produced at least 50 dB of temporary threshold shift (TTS) measured 2 min after cessation of the noise. The TTS was measured at regular intervals until recovery was complete. Results indicate that while the recovery from these high values of TTS proceeds as a function of the logarithm of time during the first few hours, later recovery is instead linear in time.

Vision

612.8

6514 INFORMATION CAPACITY OF THE HUMAN EYE WITH SPECIAL CONSIDERATION TO LOW-LEVEL ILLUMINATION. M.M.Benarie.

Bull. Res. Coun. Israel, Vol. 8F, No. 3, 167-76 (Feb., 1960).

The following expression for the information capacity, applicable to the scotopic eye, was developed:

$$N = \frac{\Omega}{\alpha^2} \log_2 \frac{C_s}{C_d} \text{ bits},$$

where N is the channel capacity expressed in bits; Ω, the total solid angle of the visual field; α, the angular resolving power of the eye at the given illumination level; C_s, the contrast of the source; C_d, the contrast threshold sensitivity of the eye at the given illumination level. This expression is analogous to that developed by Toraldo di Francia (Abstr. 6875 of 1955) and is able to give identical results at high light level and negligible stray light conditions. The present equation justifies mathematically the intuitive observation that the eye as an optical channel is unable to transmit less than about 3 bits per image. In optimal illumination conditions, the human eye has a foveal capacity of 4×10^6 bits per image. As the channel capacity of the eye is a function of the illumination level, the minimum brightness at which conditions permit the transmission of information may be found deductively. This minimum brightness is about 10^{-7} foot-lamberts, just the experimentally established order of magnitude of the least brightness perceived by the human eye. As the assumptions used in the deduction of the minimum brightness allowing the transmission of information are generally valid for any image forming device, there is a lower limit for information transmission at the brightness of 10^{-7} foot-lamberts for any image forming device. That does not mean that a device which is not image forming, e.g. a photomultiplier, cannot be sensitive to less light.

612.8

6515 BLURRING OF THE RETINAL IMAGE AND CONTRAST THRESHOLDS IN THE FOVEA. K.N.Ogle.

J. Opt. Soc. Amer., Vol. 50, No. 4, 307-15 (April, 1960).

Under carefully controlled experimental conditions, the contrast thresholds of visibility at the fovea of a point light source for a white background having a luminance of about 12 mL were determined for various degrees of out-of-focus images. Compared to the threshold for sharp imagery, the threshold was markedly increased with increase in blur of the retinal image. The mean results of three observers showed that this increase was about 10 times that for an image of white light out of focus by 1 diopter, and this threshold increased as the square of the dioptric power of the out-of-focus imagery. The results have implications in visual-search procedures. An equation, based upon (1) retinal response to a uniform luminous density in the blurred image, (2) a minimal effective angular size of the blur disk size, and (3) an asymmetry factor probably related to the character of the spherical aberration and possibly to the Stiles–Crawford phenomenon, was derived and was found to describe the data adequately. Two exposure times (1/2 sec and 1/5000 sec) and three different spectral distributions of the light from the point sources gave essentially the same results. For three subjects the minimal angular size of the blur disk was of the order of 7 to 8 min of arc in diam. This minimal size may be partially accounted for by spherical aberration, but a physiologic area effect also may be present.

612.8

6516 MAGNITUDE OF THE PULFRICH STEREOPHENOMENON AS A FUNCTION OF TARGET THICKNESS. A.Lit.

J. Opt. Soc. Amer., Vol. 50, No. 4, 321-7 (April, 1960).

When filters of unequal optical density are placed in front of the two eyes, a target which is actually oscillating in a frontoparallel plane appears nearer than it really is for one direction of stroke and farther than it really is for the return stroke (Pulfrich stereophenomenon). Measurements of the near and far displacements of an oscillating black vertical rod are obtained as functions of (a) target thickness, (b) target velocity, and (c) condition of unequal binocular retinal illuminance. The experimental data show that variation in target thickness has no effect on the magnitude of the apparent near and far displacements. Variations in target velocity and in condition of unequal binocular retinal illuminance produce characteristic effects which are shown to be in good quantitative agreement with geometrical predictions based on the theory of the Pulfrich stereophenomenon. Discrepancies in the magnitude of the displacements at low target velocities are noted and discussed.

612.8

6517 FLICKER BETWEEN DIFFERENT BRIGHTNESS LEVELS AS DETERMINANT OF THE FLICKER FUSION. E.Simonson.

J. Opt. Soc. Amer., Vol. 50, No. 4, 328-31 (April, 1960).

For investigation of flicker produced by phasic variations of the brightness level, an electronic flicker apparatus was developed for continuous variation of brightness, area, light-dark ratio, ambient light ratio, and monocular or binocular exposure. The Sylvania glow modulator tube is excited by a steady current and simultaneously by rectangular impulses, thus furnishing an ambient and a flickering light source which can be mixed at any ratio within the total light emission capacity. At the same total light emission (Talbot level), the following ratios of ambient light, in percent of the total emission, were investigated with monocular presentation: 0, 25, 50, 75, 85, and 95, at two levels of total brightness. Visual field (1.5°) and time interval ratio 50 : 50 were kept constant. There was no difference in the subjective sensation of flicker at any ambient light ratio. There was a continuous drop of the fusion frequency of flicker with increasing ratio of ambient light in three subjects. The extreme ratios (zero and 95% ambient light) were tested in 173 subjects. The drop of the fusion frequency of flicker at 95% ambient light ratio was statistically highly significant at both brightness levels, but was more pronounced at the higher brightness. A hypothesis for this phenomenon is presented.

612.8

6518 ROLE OF THE LIGHT–DARK RATIO AS A DETERMINANT OF THE FLICKER-FUSION THRESHOLD. V.V.Lloyd and C.Landis.

J. Opt. Soc. Amer., Vol. 50, No. 4, 332-6 (April, 1960).

An apparatus and procedure are described by which the critical fusion frequency versus logI functions were obtained for a range of light–dark ratio (LDR) values with two sizes of foveal area. When the data are plotted against log light pulse brightness, i.e., uncompensated, the relative positions on the y axis of the sets of points corresponding to the different LDR's vary with brightness level. When the results are shown as a function of log brightness which has been compensated according to the Talbot–Plateau law, the higher the LDR, the lower the set of points on the y axis, irrespective of brightness level. The effect of an increase in area is to raise the position of a given set of points.

612.8

6519 USE OF A FOURIER MODEL IN DESCRIBING THE FUSION OF COMPLEX VISUAL STIMULI. D.M.Forsyth.

J. Opt. Soc. Amer., Vol. 50, No. 4, 337-41 (April, 1960).

Ives (Abstr. 1980, 2265 of 1922) suggested that the fusion of intermittent light sources may be described by means of a Fourier analysis of the visual stimulus. De Lange (Abstr. 3020 of 1959) has recently revived interest in this approach by plotting frequency response curves ("attenuation characteristics") which relate the amplitude and frequency of the Fourier fundamental of the stimulus

at fusion. The resultant functions, while subject to displacement as a function of the intensity and wavelength of the test field, appear to be independent of waveform. One interesting property of this type of analysis is that the direction of analysis with respect to time is irrelevant. Given a train of pulses which consists of three periods of alternating duration, the train ABCABC···has the same amplitude–frequency components as the train CBACBA···. Further, if the three periods are square waves with on times equal to off times, these components remain the same when the on-off times within each period are reversed. It is shown that such trains of pulses, having different temporal patterns but the same amplitude–frequency components according to Fourier, have equivalent fusion points.

612.8

6520 DEPENDENCE OF THE VISIBILITY OF OBJECT ON CONTRAST, OBJECT SIZE, AND FLUX LEVEL OF ADAPTATION. W.Kroebel.

Naturwissenschaften, Vol. 46, No. 23, 645 (1959). In German.

Semi-empirical expressions are derived relating the above parameters. It is found that visibility does not improve with the adaptational level above 400 a.s.b. R.A.Weale

612.8

6521 CLERK MAXWELL'S EXPERIMENTS ON COLOUR VISION. I.B.Hopley.

Sci. Progr., Vol. 48, No. 189, 46-66 (Jan., 1960).

This is an account of Maxwell's experiments on colour mixture, performed 100 years ago. R.A.Weale

612.8

6522 APPRAISAL OF LAND'S WORK ON TWO-PRIMARY COLOR PROJECTIONS. D.B.Judd.

J. Opt. Soc. Amer., Vol. 50, No. 3, 254-68 (March, 1960).

An analysis of the results of Land's experiments with two-primary colour projections has been carried out in terms of the known phenomena of object-colour perception. It is shown that no new theory is required for the prediction of Land's result that two-primary colour projections can produce object-colour perceptions of all hues; nor for his result that many choices of pairs of primaries yield substantially the same object-colour perceptions. Land's hypothesis that when the colours of the patches of light making up a scene are restricted to a one-dimensional variation of any sort, the observer usually perceives the objects in that scene as essentially without hue, is new; several special cases of it are supported by previous work as well as Land's. This hypothesis deserves the serious attention of research workers in object-colour perception.

612.8

6523 SOME COMMENTS ON DR. JUDD'S PAPER. E.H.Land.

J. Opt. Soc. Amer., Vol. 50, No. 3, 268 (March, 1960).

Land points out that although Judd accepts his experimental results, he has interpreted them in terms of modified classical theory, and the formulae applied by Judd to the phenomena of binary projection are based on phenomena which were carefully excluded by Land from his experiments. He briefly reiterates the results of his experiments, and observes that in opposition to Judd's formulae they demand formulae which are nearly independent of wavelength and fully independent of time.

612.8

6524 NOTE ON RECENT DEMONSTRATIONS OF COLOR MECHANISMS. S.Berg and J.Forkner.

J. Opt. Soc. Amer., Vol. 50, No. 4, 394 (April, 1960).

Land's findings regarding two-colour mixture are confirmed, but his claim that the orthodox colour theory requires revision is repudiated. R.A.Weale

612.8

6525 RESPONSE OF A MODEL RETINAL RECEPTOR AS A FUNCTION OF WAVELENGTH. J.M.Enoch.

J. Opt. Soc. Amer., Vol. 50, No. 4, 315-20 (April, 1960).

A polystyrene foam model of the ellipsoid of a retinal cone receptor was uniformly irradiated by a point source of microwave energy. The contribution of the model was determined when it was irradiated by a number of different wavelengths, and when it was oriented in different directions relative to the advancing wave front. The shorter the wavelength, the greater the ability of the model to concentrate the incident energy when the model was oriented in the direction of maximum sensitivity. Further, the directionality of the functions becomes greater the shorter the wavelength. That is, for the shorter wavelengths, the sensitivity falls off more rapidly (from the maximum) for equivalent obliquity of incidence of the wave front. The implications of these findings are discussed.

612.8

6526 REFRACTIVE ERROR AND THE GREEN-RED RATIO. R.E.Wienke.

J. Opt. Soc. Amer., Vol. 50, No. 4, 341-2 (April, 1960).

Studies utilizing the Rayleigh equation have indicated that colour normal subjects may use widely varying proportions of red and green to match a standard yellow. Six subjects with known refractive errors and with normal colour vision made a series of red-green matches to a standard amount of the yellow stimulus. The green/red ratios were plotted against equivalent spherical error in diopters, and it was found that the refractive error can be used to make reasonably good predictions of the green/red ratio.

612.8

6527 INDUCTION OF FECHNER COLORS IN BLACK AND WHITE PHOTOGRAPHS. J.L.Brown.

Science, Vol. 131, 155 (Jan. 15, 1960).

612.8

6528 LUMINOSITY LOSSES IN DEUTERANOPES. C.H.Graham and Y.Hsia.

Science, Vol. 131, 417 (Feb. 12, 1960).

TECHNIQUE . MATERIALS

62

6529 METHODS OF CLEANING GLASS BY VAPOUR DEGREASING AND ULTRASONICALLY AGITATED SOLVENTS. T.Putner.
Brit. J. appl. Phys., Vol. 10, No. 7, 332-6 (July, 1959).

The production of clean glass surfaces for vacuum evaporation purposes has been studied using a number of different chemical cleaning techniques. The principal cleaning methods investigated were vapour degreasing, using a range of solvents, and high- and low-frequency ultrasonic agitation of an isopropyl alcohol bath. The cleanliness of glass surfaces after treatment was assessed from their coefficient of friction, wetting properties and adherence to vacuum deposited coatings. In terms of these properties vapour degreasing in pure isopropyl alcohol produced the cleanest surface. However, low-frequency ultrasonic agitation was the most effective method of removing gross surface contaminants. The cleaning of intricately shaped components is briefly discussed and it is shown that the gas pressure above the cleaning medium must be initially reduced to allow the solvent to enter cavities and thus provide maximum irradiation of the surface. Ultrasonic cleaning was found to be most effective when operated at low frequency (25 kc/s) with an undegassed fluid under atmospheric pressure.

62 : 538.56

6530 A HIGH FREQUENCY ELECTROMAGNETIC METHOD OF CHECKING THE PROPERTIES OF THE SURFACE LAYERS ON DETAILS. Yu.Grigulis.
Latv. PSR Zinat. Akad. Vestis, No. 7 (144), 29-36 (1959). In Russian.

The method described is based on the reflection and loss that occur when an e.m. wave penetrates a metal. By using a ferrite-cored coil with field concentrator as pick-up, contactless working at 2-3 mm distance from the detail can be used to check the properties of galvanizing, painting, nitriding etc. on details with radii of curvature down to 1.5 mm. Fairly complete circuits and specifications are given for three suitable equipments, in the first two of which the pick-up is connected with a bridge for measuring the change in the real and imaginary components of the coil impedance, whilst in the third the balance is frequency sensitive (i.e. the change in coil impedance alters the oscillator frequency). The first equipment, for instance, works at 30 kc/s and measures conducting layers of 0-50 μ and non-conducting layers of 30-600 μ on steel with an accuracy of $\pm 5\%$. D.E.Brown

62 : 538.3

6531 ELECTROMAGNETIC STIRRING OF LIQUID METALS. V.Briskman, A.Mikel'son, V.Penyaz'kova and M.Rezin.
Latv. PSR Zinat. Akad. Vestis, No. 8 (145), 59-66 (1959).
In Russian.

A travelling magnetic field, produced by an electromagnet using two alternating currents in quadrature, was used to stir the mercury in a bath. The velocity distribution in the mercury was measured at various frequencies and mercury levels, the results being presented by diagrams and graphs. The scaling laws which would govern the application of these results to industrial processes are discussed, using dimensional analysis. O.Penrose

669 : 536.48

6532 METALLURGY AT LOW TEMPERATURES. P.Haasen.
Naturwissenschaften, Vol. 47, No. 1, 1-6 (1960). In German.

An inaugural lecture reviewing selected topics.

L.Pincherle

669 : 539.17

6533 A PRELIMINARY STUDY OF THREE CERMETS BASED ON URANIUM OXIDE.
L.S.Williams, D.T.Livey, E.Barnes and P.Murray.
J. nuclear Energy, Vol. 4, No. 2, 164-78 (Feb., 1957).

The fabrication and some properties of three cermets have been investigated in outline. Fabrication by hot-pressing methods if feasible, provided an argon atmosphere is used. The thermal-shock properties of UO_2 are not improved by the addition of zirconium; however, the UO_2–Th system, at high metal contents, and to a lesser extent the UO_2–Si system, up to 60% by volume of metal, show improvement in this respect. The poor properties of the zirconium cermets are probably due to oxygen embrittlement of the zirconium as a result of reaction with the oxide constituent. The use of silicon as the metallic constituent at 20% by volume improves the oxidation resistance of UO_2 in air at temperatures up to 900°C. Addition of silicon beyond 20% has little effect on the rate of oxidation.

LIST OF JOURNALS

The following list supplements the List of Journals published with the Index to Volume 62 (1959). Reprints of the List of Journals can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free.
The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Elect. Supervisor	Electrical Supervisor Association of Supervising Electrical Engineers, 23 Bloomsbury Square, W.C.1.
Elektrofertigung	Elektrofertigung A supplement to Elektrie, published as part of that journal, but with separate pagination.
J. appl. Phys. Japan	Journal of Applied Physics, Japan Society of Applied Physics, Department of Applied Physics, Faculty of Engineering, University of Tokyo, 1 Motofujicho, Bunkyo-ku, Tokyo.
J. Coll. Arts Sci. Chiba Univ. nat. Sci. Ser.	Journal of the College of Arts and Sciences, Chiba University, Natural Science Series. Chiba, Japan.

ERRATA

Author Index (1958) p.941, col. 1, Oldroyd,J.G. : for "3557" read "3757".
Subject Index (1958) p.987, col. 2, "$MnSO_4$ solutions": transfer entry "high pressure effects 8649" to "$MgSO_4$ solutions" 3 lines higher.
p.995, col. 2, "Atomic mass, $Kr^{84,86}$": insert "8374".
p.998, col. 2, "P^{32}": delete "8299", and insert "P^{32} 8299".
p.1004, col. 1, "Cobalt compounds": transfer second entry "8892" to "Cold working".
Abstr. 3592 (1959) line 3: for "L.Levine" read "I.Levine".
Abstr. 3243 (1960) line 4: for "1958" read "1959".
Abstr. 4203 (1960) line 12: after "dioxide" insert comma, for "μ_{SO_2}" read "μ_{SO}", for "μ_{NH_2}" read "μ_{NH}".
line 13: for "μ_{PH_2}" read "μ_{PH}".
Abstr. 4431 (1960) line 7: for "γ-activated" read "γ-excited".
Abstr. 4432 (1960) line 3: insert page numbers "126-8".
Abstr. 4717 (1960) line 3: for "L.Lundén" read "A.Lundén".
Abstr. 5185 (1960) line 3: for "(1959)" read "(1957)".
Abstr. 5856 (1960) line 3: for "L.J.Cojan" read "J.L.Cojan".
Author Index (April, 1960) "Marshall,R.R." for "4313" read "3413".

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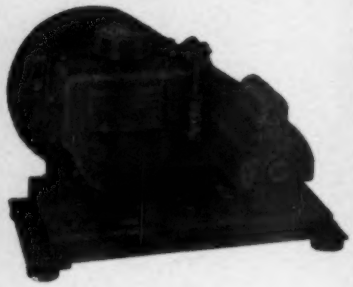

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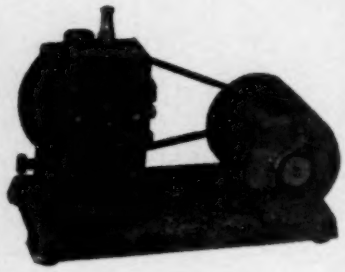

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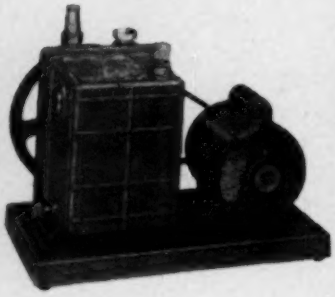

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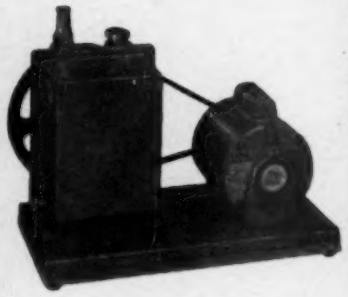

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